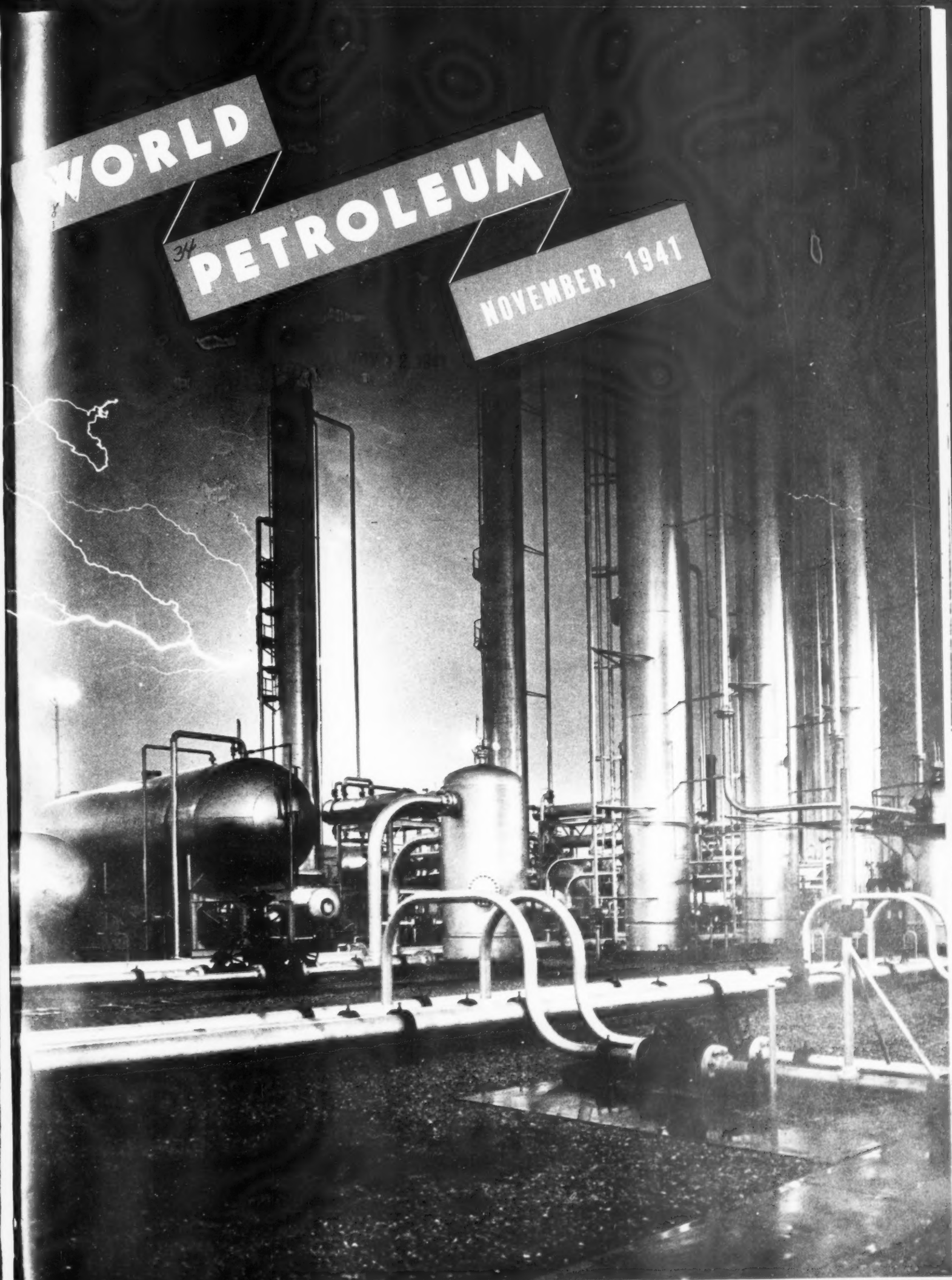
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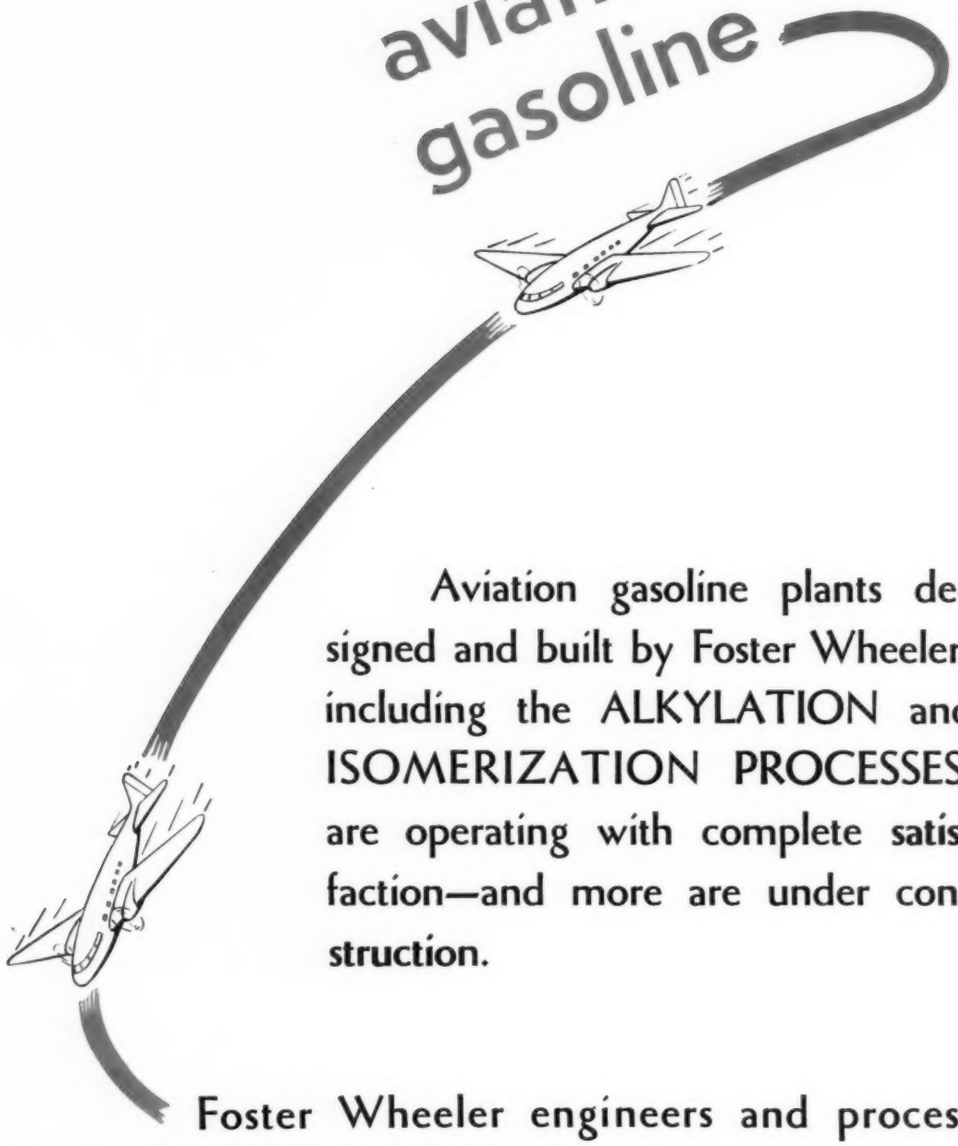

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Photograph courtesy Wyatt Metal and Boiler Works. The front cover picture shows the Cotton Valley cycling plant erected by Hudson Engineering Corp. Photo by Robert Yarnall Richie

MEXICAN OIL ISSUE CAPABLE OF JUST SETTLEMENT

At intervals ever since the confiscation of foreign owned oil properties in 1938 press reports originating in Mexico have foretold an early settlement of this and other questions at issue between that country and the United States. Of late these reports have taken on a more confident and definite form. They have agreed in specifying as a basic feature of the projected agreement a loan from the United States to Mexico variously stated at from $30,000,000 to $100,000,000. This aspect of the plan, together with the presence in Washington of high officials of the Mexican government who have spent many weeks there in discussion with representatives of the State Department, indicate that Mexico is both desirous and hopeful of arriving at a settlement of these problems. So far as published reports reveal, however, the terms proposed by Mexico are in substance the same as were offered during the Cardenas administration. The only departure is a so-called "token payment" of $9,000,000 to be taken from the sum to be loaned by the United States and to be placed in escrow, apparently as a guarantee of fulfilment of the terms finally agreed upon in settlement of the oil controversy. These terms are left for determination by future negotiation. Information reaching the public contains no suggestion of a willingness on the part of the Mexican representatives to include in the appraisal of the oil properties the value of their subsoil rights which is the crux of the whole matter. Their formula for payment of whatever amount might ultimately be fixed upon as the worth of the surface improvements made by the owners of the seized properties is to liquidate this debt, aside from the $9,000,000 which is to be conveniently advanced by the United States Treasury, through oil taken from these very properties. This oil Mexico is willing to sell on favorable terms, an option clearly unacceptable to the companies who consider themselves its legal owners.

These proposals have all been considered and rejected in previous exchanges between the State Department in Washington and the Mexican foreign office. In a series of notes addressed to Mexico in the course of this correspondence Secretary Hull admitted the right of a government to expropriate private property for state purposes but took the unassailable ground that such action must be accompanied by "adequate, effective and prompt compensation." Otherwise, he pointed out, it was in reality confiscation.

Officially the government of the United States never has departed from this position. To do so would be to issue an open invitation to any government so disposed to loot any or all American owned property within its borders. The Mexican government, in its replies to Secretary Hull's notes and in various proposals which it has put forward directly or indirectly, never has committed itself to actual payment for the properties on any basis that could be considered either prompt, adequate or effective. While it might be possible for the governments of Mexico and the United States to arrange a loan and to negotiate a trade agreement without including the long pending oil property controversy there is an evident anxiety on the part of Mexico's negotiators to have this dispute settled in any arrangement that may be reached.

There is abundant evidence of a growing sentiment in Mexico for the removal of disagreements that cloud relations with the United States. The oil controversy is one of the main causes of irritation and as such should be disposed of. The way to do this is open and requires only that the subject be approached as a business problem and abandoned as a political issue. So treated a settlement could be reached on a basis that the oil companies could hardly reject while at the same time it would avoid any loss of face on the part of the Mexican government; on the contrary it would serve the nation's present and future interests to the greatest advantage.

Not even among those in Mexico who uphold the action of President Cardenas in seizing the oil company properties is it contended that the operation of the properties by the government has been a success. Various reasons are advanced to explain the discouraging experience. Two of these reasons are obvious to an impartial observer. One is the government's lack of capital to provide and maintain the industry in efficient condition. The other is the lack of men of technical training and ability to direct the tasks of exploration, field development and refinery operation necessary to keep the industry in permanently sound working condition. As these deficiencies have been acknowledged in the highest quarters of Mexican officialdom the statements cannot be questioned or be termed controversial.

Under these circumstances the logical course for Mexico is to take the steps necessary for ultimately successful operation of the oil industry before becoming further involved in the financial and operating difficulties with which it is now beset. It can do this without sacrificing its objective of state ownership of subsoil mineral rights

or relinquishing plans for state management of the oil industry when it is in a position to undertake that task. The way to accomplish this is to enter into an operating agreement with the companies formerly holding the properties. This operating agreement would run for a specified term of years at the end of which time the properties and all their appurtenances would be turned over to the government. The rights of the operating companies would be protected by specific provisions in the agreement and the companies on their part would undertake to maintain social and educational services for their employees and to provide technical training and practical experience for a certain number of Mexican youths who would gradually fit themselves to fill key positions in the various branches of the industry. Under such an arrangement Mexico would relieve itself of the financial burden imposed by the losses incurred under government operation of the industry and would again enjoy the substantial revenues formerly received through taxation. Its oil industry would be restored to a position of efficient operation and importance in international trade. Its reserves would be maintained and built up instead of facing early exhaustion as at present. More important still it would gradually acquire a highly trained personnel among its own nationals who would be capable of directing successfully the all important technical operations of the industry when the time arrived for the state to take full possession of the properties after having satisfied the reasonable claims of their owners for surrender of their concessions.

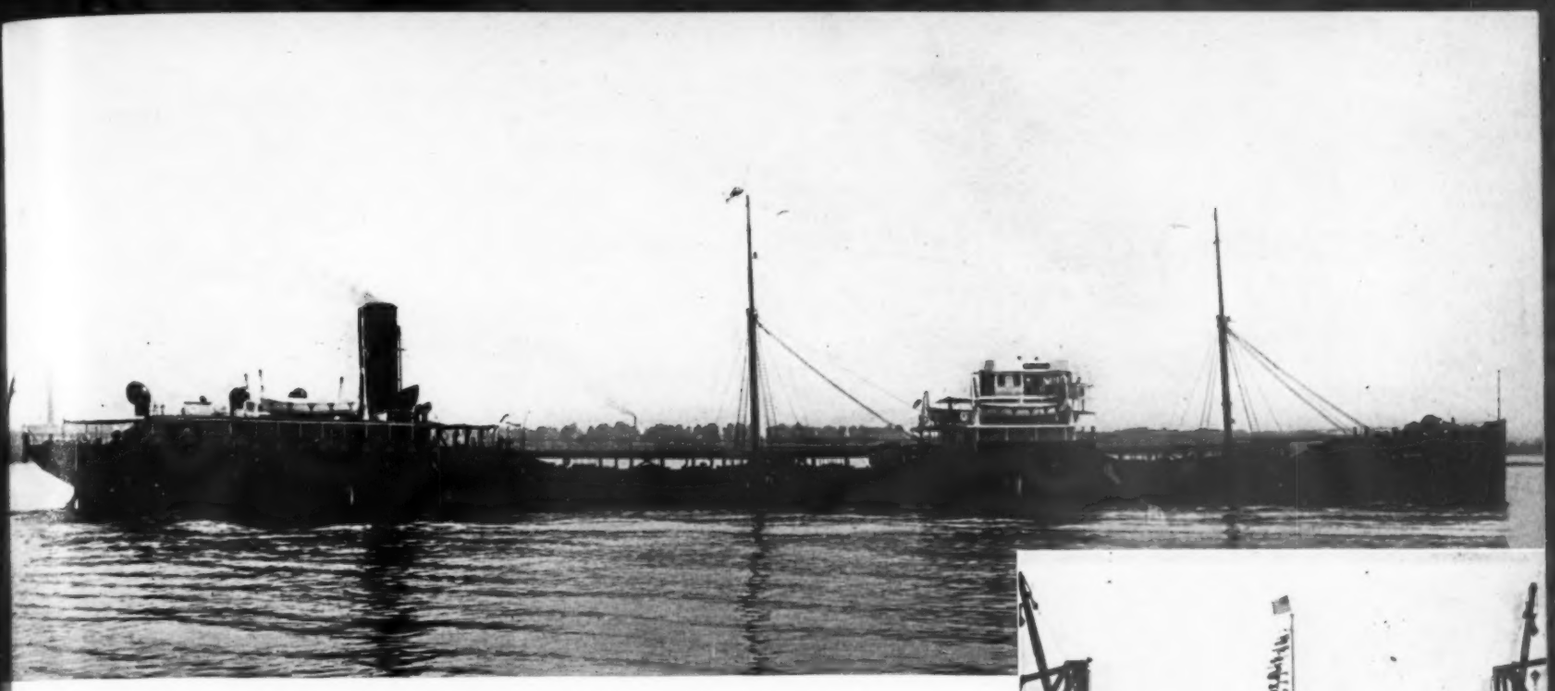
This is not a fanciful picture. It provides a practical working agreement such as is actually in effect in other parts of the international oil world today. While the oil companies would have to relinquish perpetual possession of their properties to which they may be legally entitled under the terms of their concessions they would have the opportunity to obtain a return from their investment provided they were able to handle the business successfully during their term of operation. The Mexican government would attain its main objective by establishing the title of the state to ownership of petroleum resources, accomplishing this by fair and legally defensible means. It would thereby remove the stigma attaching to past confiscatory proceedings and would provide an assurance of fair treatment of legitimate and well intentioned investors that would be of more value to the industrial progress of the nation than any loan that it could possibly obtain, no matter what its size.

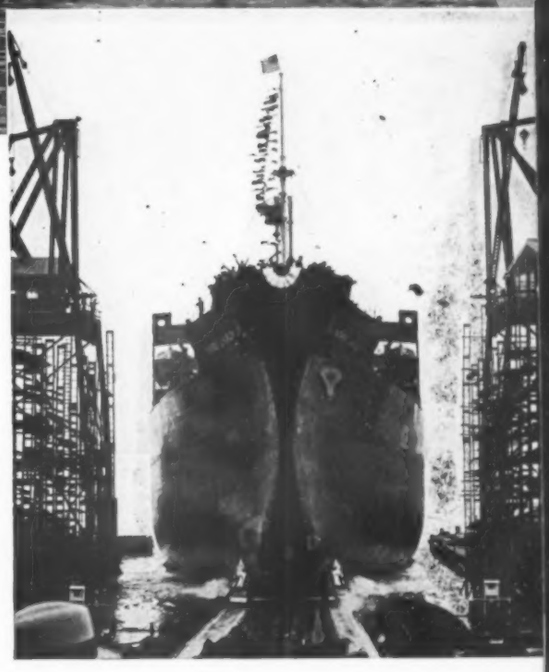
RELATION OF PRICE TO OIL INDUSTRY EFFICENCY

To maintain the efficiency of the oil industry of the United States, to meet the mounting demands made upon it, to avoid needless waste and to assure a continuing supply of petroleum products at a reasonable price it is of primary importance that existing sources of supply be maintained and that the work of exploration by survey and drilling be carried forward without lagging. The vital nature of such activity has been recognized by Deputy Coordinator Davies, by Robert E. Allen, director of the division of production in the OPC and by others. Attention has been called to the fact that for the first time in many years withdrawals of crude are of greater volume than discoveries of fresh reserves. Continued existence of this condition obviously would lead in time to a real petroleum shortage with attendant high prices and dislocation of industry.

Maintenance of exploration, however, is not merely a matter of providing machinery and supplies. The chairman of Phillips Petroleum Company brought this out clearly in his proposal for an increase in crude prices addressed to Price Administrator Henderson. "Because price controls exploratory effort," the message said, "and because price determines the economic life of small wells of settled production it is the most important single factor affecting the nation's reserve supply." Mr. Phillips pointed out that the petroleum industry had reached a stage where normally the price of crude would have risen and exploratory work would have increased but that this has been prevented by price restraints. He enumerates four reasons for an increase in crude prices which as he observes would involve a relatively small advance in product prices. These are in brief: (1) The stimulating effect of price on exploration is the only effective and practical means of reversing the declining rate of discovery; (2) Costs of finding new reserves have risen threefold since 1937 and are steadily increasing; (3) The cost of finding, acquiring and producing crude has increased 42 cents a barrel since 1937; (4) Rising costs of labor, material and taxes are affecting the entire production situation and are threatening small wells of settled production with premature abandonment.

These are aspects of the situation that cannot be ignored. They call for a revision in the procedure of price regulation which heretofore has dealt only with symptoms and not with underlying causes.





Top, the tanker Olean one of 40 that were transferred to British shuttle service earlier in the year and are now being returned to the American owners. Launching of the new Sinclair 17,000 ton tanker, Patrick J. Hurley from the Federal Ship's yard at Kearney on October 21. Photo by Acme Newspictures.

Tankers Totaling Two Million Gross Tons On Order

ADDITIONS to the United States tanker fleet which will make it the largest in the world are being rushed to completion in U. S. shipyards. With 360 oilers of American ownership now plying the seas and 204 additional ships of this type on order or under construction, this country will have in service on completion of these orders 564 tank ships comprising the most modern fleet of its kind in the world. Great Britain, heretofore the largest tanker owner, is estimated to have 432 vessels of this type according to an announcement of the Maritime Commission. The occasion for the announcement was the placing of orders for 49 new tankers by the Maritime Commission early in October.

In July, WORLD PETROLEUM reviewed the tanker situation finding that there were on June 1, 1941 no less than 140 tankers totaling 1,333,060 gross tons on order or under construction in American shipyards. Of these 63 units aggregating 595,460 gross tons were for private interests and 77 vessels totaling 737,600 gross tons were for the Maritime Commission. Sun Shipbuilding & Dry Dock Company had the majority of orders for special tankship construction. The Maritime Commission had on order and under construction with Sun, 77 tankers; Standard Oil Company of New Jersey was the second largest customer having 13 vessels on order. Atlantic Refining Company had ordered three from this yard, The Texas Company had three under construction there, Standard of California had ordered two, Gulf Oil Corporation two, and Keystone Tankship Corporation two. At that time Sun Oil Company and Petroleum Shipping Company, Ltd. each had one tanker on order at the Sun Shipbuilding yards. Bethlehem Steel had orders for 28 tankships at their Quincy, Mass., and Sparrows Point, Md., yards: Eight of these were for Socony-Vacuum, six for Sinclair, five for Union Oil Company of California, two each for Gulf Oil, Petroleum Shipping Company and Panama Transport Company. Continental Oil Company, Richfield and Jersey Standard had each ordered one tanker from Bethlehem. In addition to the above orders, Federal Shipbuilding was constructing four tankers for Sinclair, Welding Shipyards of Norfolk, Va. had an order for two tankers for the account of National Bulk Carriers and Alabama Drydock & Shipbuilding Company had an order for one tankship for the same company. Tidewater had one tanker on order with Charleston Shipbuilding & Drydock.

During the summer (June 1 to October 1), according to the reports of the Bulletin of the American Bureau of Shipping, four tankers were launched from the Sun Shipbuilding yards, two for Jersey Standard, one for Petroleum Shipping and one for Atlantic Refining; five tankers were launched from Bethlehem's two yards, two for Sinclair, one for Socony-Vacuum, and one for Union Oil of California; one tanker was launched from the yards of Federal Ship and delivered to Sinclair. Also during this period 10 new orders were placed for private interests, all with Sun Shipbuilding, consisting of three for the account of Petroleum Shipping, two for Atlantic Refining, two for Sun Oil, and three for The Texas Company. By far the largest order came from the Maritime Commission, which commissioned Sun to construct 15 tankers for its account in addition to the 77 then on order with this yard for the Commission. Altogether during the summer and exclusive of the October order placed by the Maritime Commission, 103,800 gross tons of tankshipping have been ordered by private interests and 131,750 gross tons for the Maritime Commission, making a total of 235,550 gross tons on order in addition to the 1,333,060 tons on order prior to June 1. During the summer 94,500 gross tons of tankships were launched for private interests. The Maritime Commission's most recent order placed in October of this year covers 49 tankers totaling 526,750 gross tons. The Commission has orders for 36 of these ships with the Alabama Drydock & Shipbuilding Company at Mobile. These will all be vessels of 10,750 gross tons, 503 ft. in length, 69 ft. beam, and 39 ft. 3 in. draft. They will have a capacity of 138,000 bbl. each and a speed of 14½ knots. They are to be delivered between August 1942 and December 24, 1943. The remaining 13 tankers will be constructed at the Sparrows Point yard of Bethlehem Steel and will have the same gross tonnage as the Mobile ships but dimensions will be slightly different: 487 ft. 6 in. length, 68 ft. beam, and 37 ft. draft with a speed of 15½ knots.

Mexican Oil Industry Nearing CRITICAL

Dominant communist influence in Mexico during the Cardenas administration caused the oil property seizure to assume the aspects of a class war in its initial stages: Here daughters of Mexican soldiers parade before President Cardenas in 1938 proclaiming their support of his move against the oil companies.

Despite Government Assistance Industry Operates at a Loss While Labor Disputes Grow More Acute—Look to U. S. Agreement Coupled with Liberal Loan to Avoid Chaos.

DIFFICULTIES of the Mexican government in running the oil business, cumulative since 1938, have become acute during the present year. Various factors have helped to accentuate the government's problem. Prominent among them is Mexico's chronic ailment, labor trouble. War conditions have upset the trade agreements with Germany and Italy which were relied upon to provide export markets independent of the United States. Production has declined. Plant and equipment are steadily deteriorating. Unless the Mexican administration does something drastic and does it quickly the industry, in the opinion of well informed observers, will be in peril of virtual collapse. This conclusion may be a bit too sweeping but there are numerous signs that the government, in western vernacular, "has a bear by the tail" and would like to let go if it can find a politically feasible way of doing so.

Color is lent to this belief by the fact that Mexico has reopened the discussion in Washington of issues outstanding between the two governments and appears to be more anxious than at any previous time for a settlement of these questions, including that of the oil properties seized from American investors. The fact that the three Mexican officials who have been spending much time in Washington in connection with the projected agreement are holdovers from the previous administration might be held to militate against an adjustment of the oil controversy acceptable to the United States. On the other hand there is the possibility that this was a consideration in their selection since the whole unpleasant oil mess is looked upon as a heritage from the Cardenas regime and the political future of the negotiators may be affected by their ability to find a

SITUATION

way out of the complications that have resulted from it. This is merely political surmise.

Although Mexicans were repeatedly told during the period between 1938 and 1940 that the oil question was definitely disposed of by the expropriation decree of March 18, 1938, and the nationalization of oil and other natural resources, the question and the problem of its settlement are again in the spotlight in Washington and in Mexico City. All reports concerning the subject agree, moreover, in the expressed expectation that the settlement will be closely associated with a substantial loan or credit to Mexico. The idea in Mexico City financial circles seem to be that a loan and a credit will be one and the same thing and that "a few million dollars mean nothing to the United States right now." But there are frowns when it is hinted that this expected financial accommodation would be a gift. The anticipated big money from Washington would not be particularly needed to strengthen the peso, it is generally held in Mexico City financial circles, because the present rate of 4.85 per dollar is considered most convenient for the national economic scheme. It means more pesos from exports; it maintains Mexico's main industry, which is mining, and gives a better return from foreign sales of oil and other products which are marketed on a dollar basis. Such money, therefore, as Mexico may obtain from the United States, whether called a loan or a credit or an exchange stabilization fund, would be used in part, in the opinion of most Mexicans, to help Mexico meet financial obligations involved in a settlement of the oil controversy.

It is difficult to obtain trustworthy details of oil operations in Mexico because no official figures have been published by the Ministry of National Economy since the oil seizure of March 1938. No annual accounts have been issued by Petroleos Mexicanos. It is only possible, therefore, to analyze the present situation of the industry from statements made from time to time by the President, by the management of the government company, Petroleos Mexicanos, and by manifestos issued by the syndicate of petroleum workers. These statements are in some respects conflicting but they illustrate the existing dissatisfaction of both labor and management with the present situation in the industry.

In his annual address to Congress, the President gave the following figures of oil production:

Year	BBL.
1937	46,805,000
1938	38,467,000
1939	42,890,000
1940	42,517,172
1941 (Jan.-June)	20,068,231

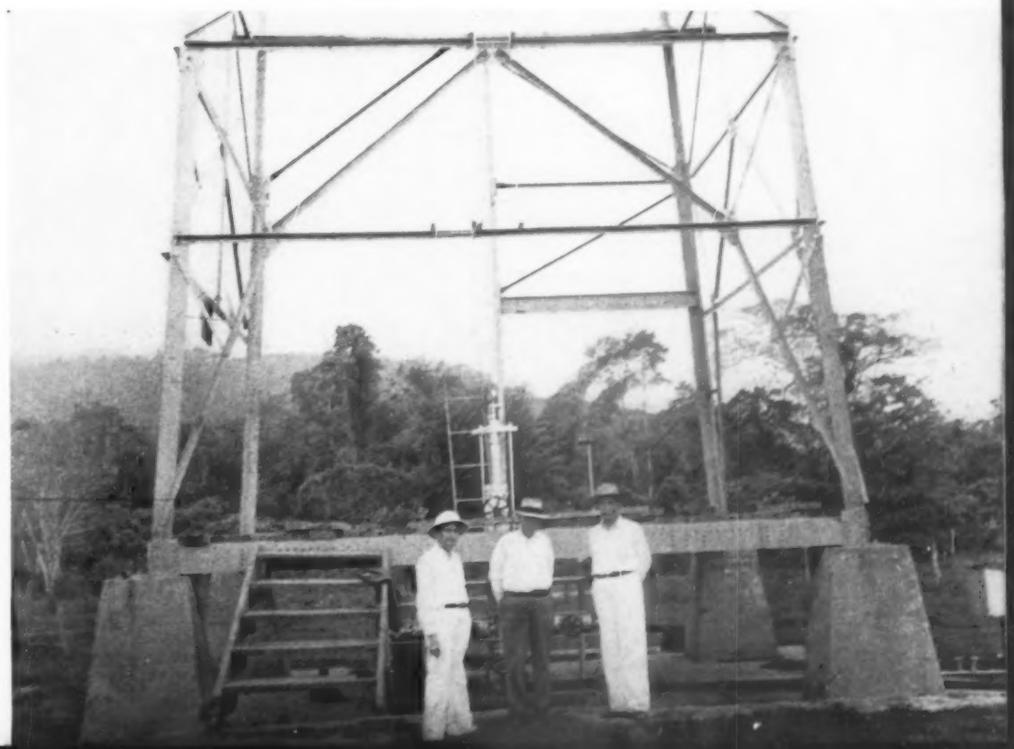
Later, in his report, the President stated that present market demand amounted to 145,000 bbl. daily, of which, he stated, 94,000 bbl. were treated in the refineries. The figure of 20,068,-231 bbl. previously given for the six months of 1941 represents, however, only approximately 110,000 bbl. daily and responsible private sources in Mexico City say that current oil production is between 86,000 and 91,000 bbl. daily, of which something like 75 percent (65,000 to 70,000 bbl. per day) is refined within the country.

The President later stated that "domestic consumption shows a manifest increase during the past three years, which allows us the certainty that we shall soon be independent of the international market to which we are still subjected in large measure. It is a fact that any industry in the process of development must have within the country in which it is working a market sufficiently broad so that it can establish thereupon the firm and stable basis which will allow it to take the successive steps required by its regular development." The chief executive reported the value of home sales at 154,664,000 pesos in 1938, 169,954,000 in 1939, 191,368,000 in 1940, and a record of 106,338,000 during the first half of 1941. He then went on to say that there had been an average daily increase in refined petroleum from 89,008 bbl. to 93,750 bbl. during the first semester of 1941. "This," the chief executive added, "has been possible as the result of increasing and broadening the domestic market which will soon be the basis of our petroleum industry." The above passages quoted from the President's speech have aroused some comment in Mexico City as they would appear to indicate that the Mexican government foresees a time when the internal consumption of the country will absorb its total oil production. This undoubtedly would be a serious blow to the economy of the country which, in the days of private ownership, received a substantial proportion of the national income from the export of petroleum products. On the record of developments under government operation it is admitted that Mexico is heading towards a situation which will jeopardize its position as an exporter of petroleum.

In a report rendered to the government in October, 1940, a commission of experts appointed to examine the state of the industry made the following statement on the subject of exploration:

"The detailed study of the production which Petroleos Mexicanos now has, as well as the examination of the charts of production of explored fields, convinces this Committee that there do not exist in the country known reserve fields for the maintenance of production which would meet, in a not too distant future, the require-

Poza Rica, discovered and developed by the oil companies, gave the Mexican government a sense of security in seizing their properties: As a flush field it required no special attention for the first few years after the seizure.



ments of the domestic market and of exports. With the exception of Poza Rica the fields now under exploitation have had a productive life of between ten and twenty years; at the present time they are in a manifest period of decline, and are rapidly approaching exhaustion. It is calculated that within a period of seven years, the fields will slowly be exhausted and that their total production will no longer be profitable, for operation would represent expenditures greater than the value of the petroleum extracted, because it is being made through numerous wells, distributed through various caps in extensive lands, whose maintenance is very expensive. There are no productive camps, properly speaking, that is, in flush fields, except that of Poza Rica. This has an exploitation capacity conservatively rated at 20,000 cubic meters (125,000 bbl.) a day, once the drilling program of the field has been completed, and has a life of expansion over a period of seven years, after which the field will start to decline until its complete exhaustion in ten or fifteen years more."

That this danger is recognized by Mexico is apparent not only from the President's insistence on the necessity for an expansion of the internal market, but by the announcement in his Presidential message that geological and geophysical exploration, which was suspended immediately after expropriation, had been resumed. It was, however, admitted that the suspension of exploration was due chiefly to a shortage of specialized technicians, and it is scarcely to be expected that Mexico has been able to muster an adequate number of experienced geologists and geophysicists able to cope with this difficult and highly specialized branch of the oil business.

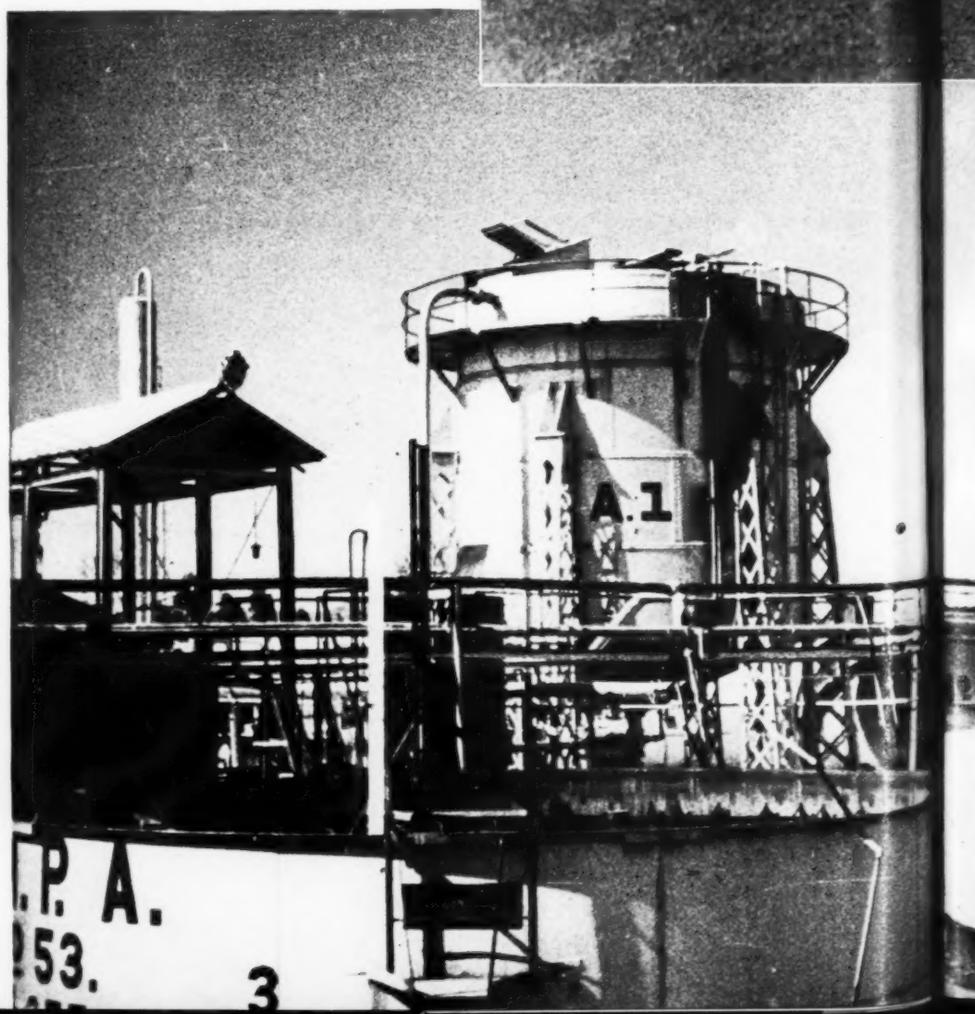
Regardless of prospects for future production it is unlikely that there will be a shortage of crude oil in Mexico for the next few years. Reserves in the Poza Rica field are believed to be high, and all that the Mexican government will have to do to meet its petroleum needs will be to drill up locations already discovered and proved by the former companies. The government's main problem at present, so far as mechanical operations are concerned, is one of refining. The gravity of this problem is forcefully brought out by the fact that, whereas prior to 1938 well over 79 percent of the petroleum exports from Mexico consisted of refined products suitable for immediate marketing, it is now estimated that over 70 percent of the greatly reduced export business consists of crude oil. Moreover, publicity has been given to the fact that Petroleos Mexicanos is blending back with the export crude oil large quantities of semi-refined gasoline as their refinery equipment is not such as to produce a gasoline which can be sold for export. In addition to this considerable quantities of high octane gasoline have been imported into Mexico although it is claimed that this gasoline emanates from Mexican crude oil refined at Houston.

In his message to Congress, the President remarked on the flourishing state of the domestic sales of oil within the country. Two factors have contributed to this; one is the tremendous increase in tourist trade in Mexico, and the other is the government's successful efforts in improving road systems within the country which has led to a more extended use of automobiles. Official claims have been made that there has been also a considerable increase in consumption of oil products by the railways. As mentioned earlier, no statement of accounts has ever been published by Petroleos Mexicanos. By correlating such figures as have been quoted officially on various occasions, however, a reliable indication of the financial condition of the industry may be obtained. At the end of 1939, President Cardenas quoted the following figures corresponding to that year:

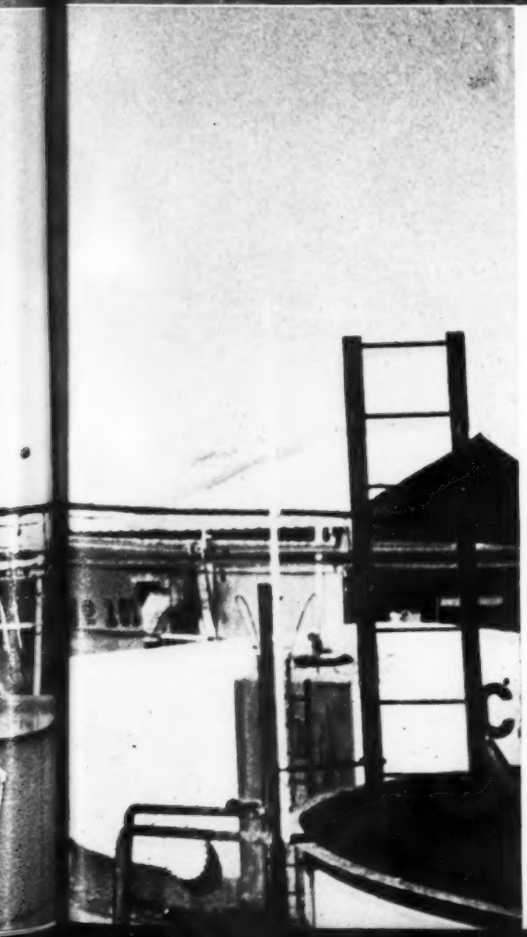
	Pesos
REVENUE:	
Sales in the domestic market	172,000,000
Export sales	75,000,000
Total	247,000,000
EXPENDITURES:	
Cost of operation and production	130,000,000
Taxes	70,000,000
Purchase of equipment, plant and materials	56,000,000
Salaries, wages, and similar expenses	71,000,000
Total	327,000,000

The foregoing shows a deficit for the year 1939 of 80,000,000 pesos. In a statement published in the press on 18th March, 1941, Senor Buenrostro, the general manager of Petroleos Mexicanos, compared certain figures for 1940 with those for 1939. He stated that while the net value of export sales in 1939 after making certain deductions amounted to 32,000,000 pesos;

Below, one of Aguila (Shell) refineries in Mexico. While under the control of skilled engineers these plants functioned efficiently; under government management, in untrained hands and with repairs neglected they deteriorated rapidly, leading to Mexican charges that the plants were in a state of disrepair at the time of their confiscation.



in 1940, on the basis of the same deductions, export sales had a net value of only 6,500,000 pesos, involving a reduction in income of 25,500,000 pesos. He further pointed out that, in 1940, wages and capital investments increased as compared with 1939 approximately 9,000,000 pesos. Combined, these items amount to 34,500,000 pesos, and, even allowing for the increased volume of domestic sales during 1940, it would seem that whereas 1939 resulted in a deficit of 80,000,000 pesos the year 1940 ended even more disastrously with a deficit of between 90,000,000 and 100,000,000 pesos. All in all, financial circles in Mexico City believe that the total deficit of Petroleos Mexicanos during its three and one-half years of operation cannot be less than 350,000,000 pesos. It has been officially stated that taxes on the industry in 1939 amounted to 70,000,000 pesos, and that for the first half of 1941 they amounted to 34,126,000 pesos. Assuming, therefore, an average figure of 70,000,000 pesos a year for taxes due to the government by the oil industry, this would imply that in the three and one-half years since the oil expropriation the government has foregone approximately 250,000,000 pesos in taxes, and has had to subsidize the industry with at least an additional 100,000,000 pesos. In addition to these losses to date, money must be found to finance the highly expensive work of exploration and exploitation in new fields, without which the industry will succumb; to modernize refinery plants essential to supplying products at least to the domestic market; and, eventually, to pay for the fleet of tankers expropriated from Italy. It is significant that, in order to cut down the deficit of Petroleos Mexicanos, the Mexican government in January 1941 put into effect reductions in the production taxes (payable on exportation) on petroleum whereby, for instance, the tax on light crude became 9.75 cents (U.S.) per barrel as compared with 21.25 cents (U.S.) per barrel on the previous basis. In August 1941 Petroleos Mexicanos was exempted from income tax and stamp taxes on invoices covering sales. These are among the many evidences that have accumulated that the government-run oil industry has become a heavy national burden.



Above, a section of the Laredo-Mexico City highway which is to be a link in the Pan American Highway connecting North & South America. For extension of this road, Mexico hopes to obtain $30,000,000 from the U. S. Export-Import Bank, a loan that has been delayed by failure to reach an acceptable settlement of the oil controversy.

Although the ostensible reason for seizure of the oil properties in the first place was refusal of the companies to accept the terms of a labor board award it cannot be said that the course of labor relations has been smoother under government operation. As a matter of fact, in the earlier dispute, the oil companies agreed, before the expropriation decree was issued, to grant the wage increases and the social benefits demanded by the workers and rejected only the clauses that would have deprived them of the right to manage their business, but their action was without effect in stopping the course that the communistic elements then in the ascendency had decided upon. Under government operation the workers have not been able to obtain the full advantages of the terms to which the oil companies had agreed and this has been responsible for much of the friction that has existed since the government took over. The workers find themselves in a more difficult position than formerly in attempting to enforce their demands, for the government, which was willing to give them all support and encouragement when these demands were directed against private employers, takes an entirely different attitude now that it will have to foot the bill for higher labor costs. Protracted strikes have been prevented and even the *paros* or short strikes, none of which lasted more than a day, have now been curbed, but this has been done through strong action on the part of the government, involving in certain cases the employment of federal troops to enforce administrative control in the fields and refineries. Through these occurrences and frequent disputes between the oil management and the employees labor has become more and more disgruntled. There is much talk of striking, and it is reported that a strike order has been prepared ready for issuance at any time. But the government has announced that it will not countenance a shut-down of the industry for even a day. Conversations that are called "conciliatory" have been held for some time between Petroleos Mexicanos and representatives of the employees. Concrete results, however, have seldom resulted, and it has become a commonplace to see paid advertisements in the daily press published by the

union attacking the management of Petroleos Mexicanos, and equally bitter statements directed against the union and published by the management itself couched in terms that would not have been tolerated before confiscation.

Government authorities have called the oil labor leaders demagogic. The oil labor leaders have called the labor authorities and the management of Petroleos Mexicanos by much harder names. Efrain Buenrostro, managing director of the government oil company, is in a difficult situation. He was one of the three government experts who examined the oil companies' books shortly before expropriation, and reported that the companies were well able to meet the higher pay and other demands of their employees. Now, with the boot on the other foot, he has to explain to the labor leaders why under his management, the industry is unable to pay the benefits which he previously said the companies could so easily meet. There is further irony in this dispute. The workers recently demanded, and Petroleos Mexicanos agreed to, the removal of Lic. Gustavo Corono of the petroleum staff Readjustments Committee, but Gustavo Corono, a lawyer, was chairman of the special labor board that rendered the award, refusal of which caused the oil companies to be declared in rebellion and paved the way for expropriation. The oil workers' union has been running full-page advertisements in Mexico City newspapers for the purpose of "advising the public of Mexico of the nature of this case and who is responsible for it." These advertisements assert that the principal reasons for the conflict between labor and management are the following demands of Petroleos Mexicanos, all of which are objectionable:

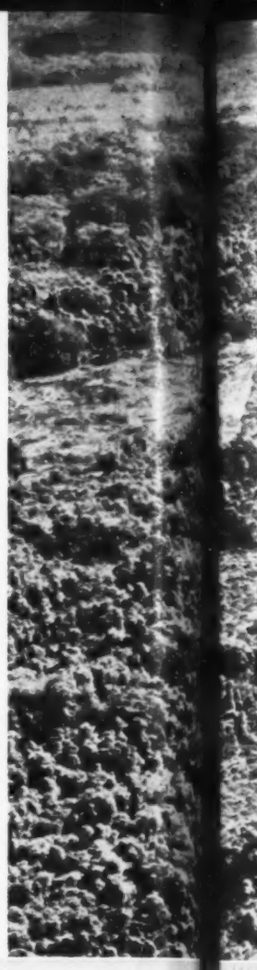
"Constant and permanent reduction of personnel, on the basis of allowing the administration (the company) faculties to choose those who shall be dismissed, without regard to the right of seniority; adjusting the internal structure of the union to the desires of employers; desire of the company to increase the number of confidential employees, the company forgetting that its very legal and economic origin is closely bound up with national interests and absolute respect for the law; reduction of workers' pay on the pretext of establishing wage scales of a general nature, thereby breaking the economic unit of the award of December 18, 1937 (which granted the workers full pay for their strike of 12 days in the spring of 1937 and all demands with regard to new working conditions with the companies) even though this has been accepted as a guide for the solution of problems in the oil industry."

According to official figures, at the end of March 1938, after the seizure, there were 15,895 men on the payroll, and the total wage and benefit payments over 1937 amounted to slightly more than 55,000,000 pesos. This represented an average age yearly wage of approximately 3,500 pesos, or, at the then rate of exchange, almost $1,000. During 1939, total payments by way of salaries and benefits were stated to have amounted to Pesos 102,928,000 but during this period the total number of employees had increased to 23,073. This latter represented an average yearly wage of 4,460 pesos, or at the then rate of exchange, only $750.00 (U.S.) per man. Although the peso wage is higher the cost of living has increased in Mexico, roughly in inverse ratio with the drop in value of the peso (today approximately 30 percent), and according to the union charges the increase in total labor costs was due almost entirely to loading in personnel and not to wage increases or extension of benefits to the lower categories of workmen. The unions claim that the only ones who have benefited are the higher administrative employees whose salaries have been increased, and that many unnecessary positions have been created at exaggerated scales of pay to be filled by political appointees and personal friends of officials.

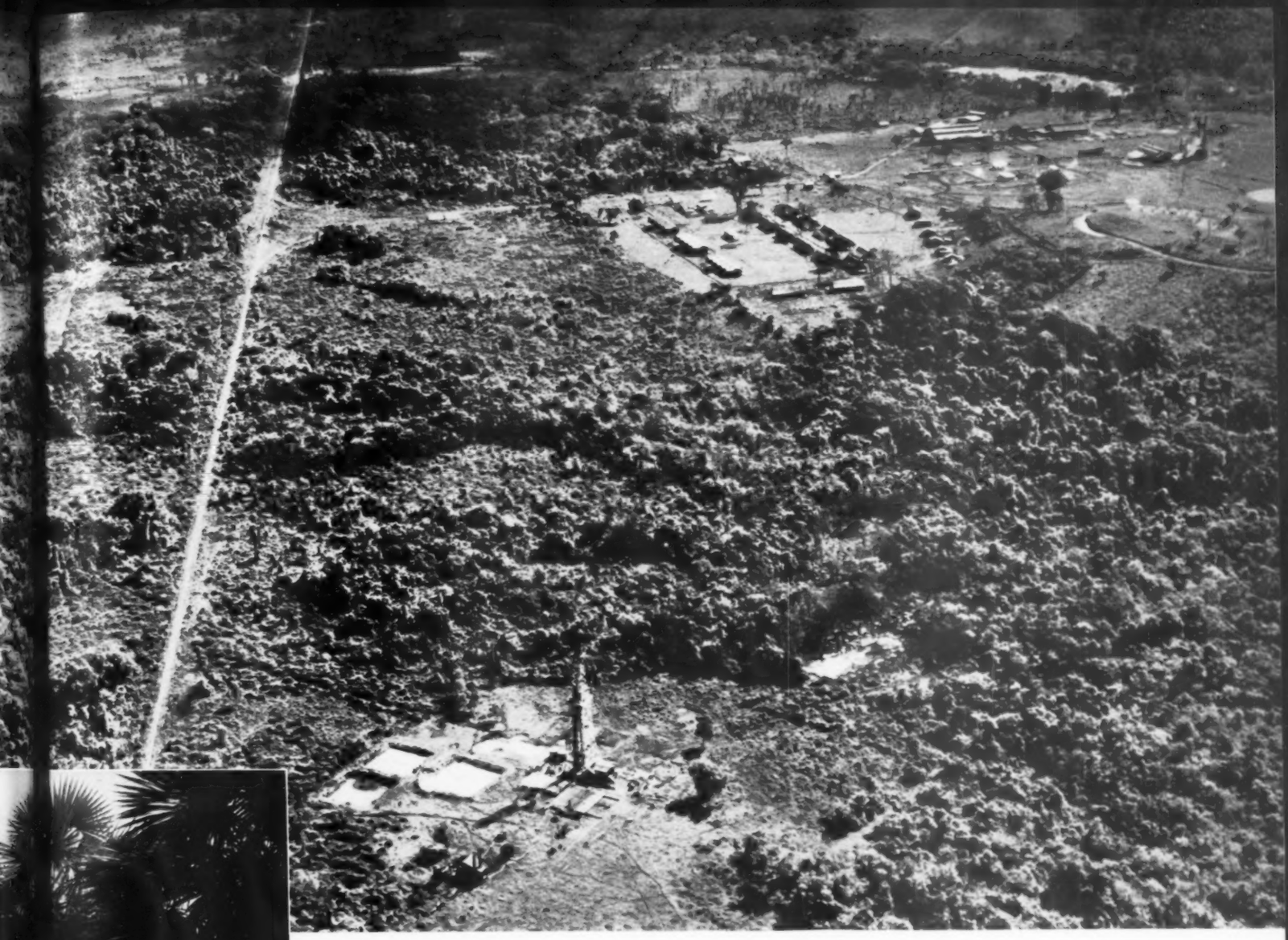
Following upon the expropriation, the wage scales established by the famous award of December 1937 were generally imposed but with discounts running from eight percent in the lowest brackets to 25 percent in the highest. However, depressed financial conditions compelled Petroleos Mexicanos to institute, during 1940, action under the federal labor law to prove their "economic incapacity" to pay even the wages thus discounted so as to obtain authorization for a reduction in the wage scale and in the other costly concessions claimed by the workmen. The award which emanated from this second "economic conflict" effectively lessened social and economic benefits to the workers. Hours of work have been increased; free housing has been partially suspended; vacation periods have been reduced; payment of overtime has been curtailed; and medical benefits have been lowered. In addition many workers have been dismissed and the administrative authority of the management of Petroleos Mexicanos in dealing with the workers has, nominally at least, been strengthened.

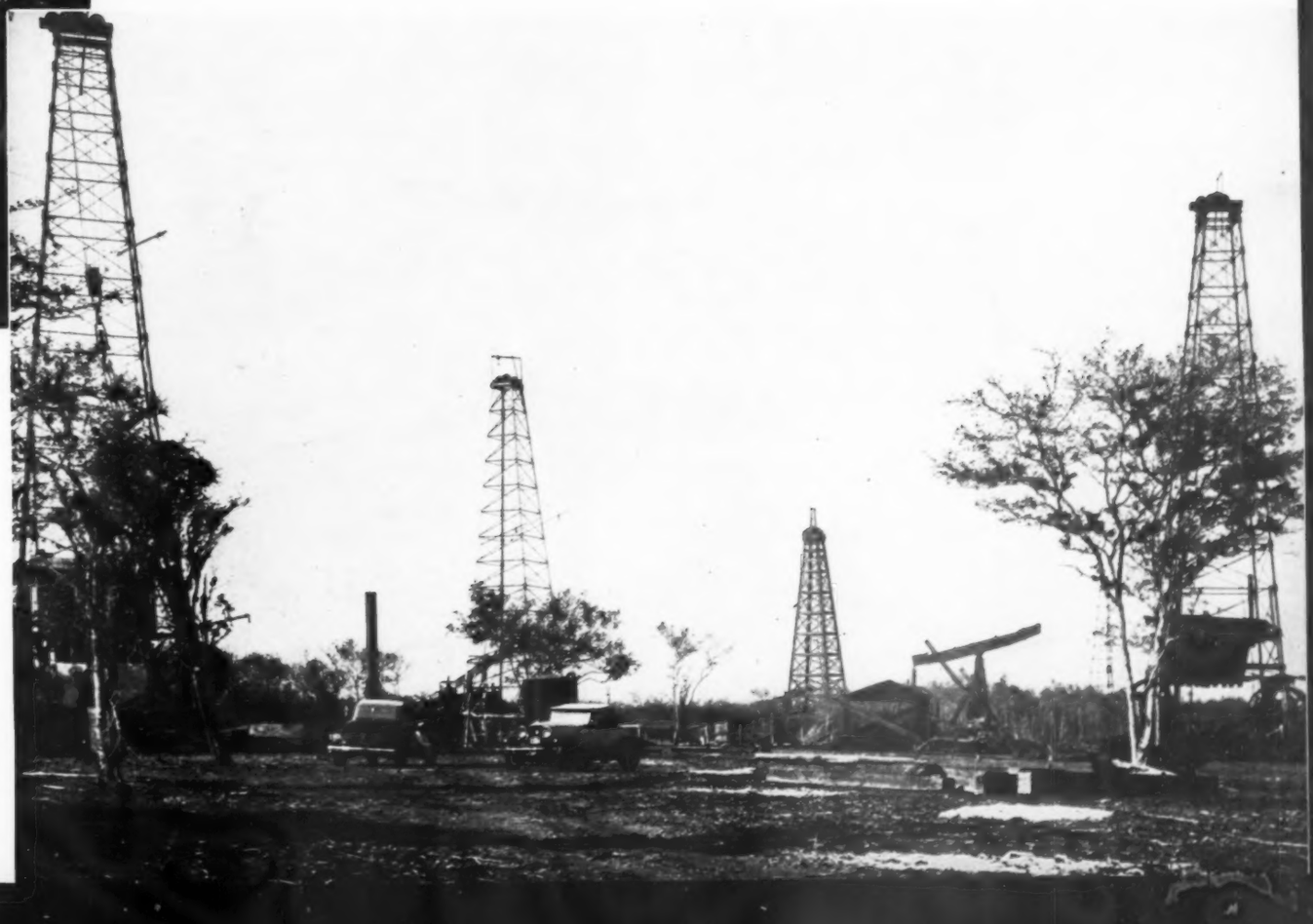
The latest development in the Mexican government's operation of the oil industry is an attack which has been directed against the management by Congressman Meraz Nevarez who accuses the senior officials of the company of wholesale graft and fraudulent sales of oil and its products, and has demanded that a public investigation into the state of the oil industry should be carried out by the House of Representatives and that action should be taken against those found guilty of betrayal of their public trust. In a lengthy statement the members of the board of administration of Petroleos Mexicanos declared that the legislator had erred in charging manipulation in the financial transactions of the company, and asserted that its fiscal phases are being conducted in a businesslike manner. However, the Congressman returned to the attack and his detailed accusations have been given much publicity in the daily press.

In many respects the pathway of oil property confiscation laid out by President Cardenas has proved a thorny one for Mexico. It has imposed a heavy financial burden on the government which it was ill prepared to meet. It has disappointed the oil workers who assert that they have not received the benefits promised them. It has led to serious friction within the country and has given it a reputation abroad that, it is feared, may keep private capital from entering Mexico if the oil controversy is not included in a general settlement with the United States which, it is expected in Mexico, will soon be reached.



Right and below, views of Poza Rica, discovery and development of which in a sense helped to touch off long standing plans to seize British and American oil properties. Airview by Mexicana Aerofotos, S. A. Below right, the famous Sabalo-Chapacao section of the Panuco field where production has been allowed to languish since Mexico's agreement to barter oil with Germany was ended by the outbreak of war in Europe.





OIL PRIORITIES System Being Worked Out

WASHINGTON, D. C.

WITH the eastern petroleum "shortage" officially declared off and the controversial transportation issue thereby relegated to a minor position priorities remain the preoccupation of oil men and the big problem of the Washington bureaus having to do with the adjustment of essential materials to national needs. The situation as to this vexing question is being gradually clarified under the reorganization put into effect some weeks ago by which all priority matters were brought under control of the Supply Priorities and Allocation Board and specifically assigned to determination by Director Donald M. Nelson of the Office of Production Management. Pending completion of a survey of industry requirements as a basis for allocation of materials needed for exploration, drilling, refinery maintenance and construction and expansion of transportation facilities several steps have been taken to simplify procedure and dispel the confusion that has existed heretofore as an obstacle to this work.

Under order of S P A B the survey is being made jointly by the Priorities Division of OPM and the Office of the Petroleum Coordinator. In connection with the survey Donald M. Nelson, Director of Priorities, has received reports from the regional chairmen of petroleum industry committees and from a committee of equipment manufacturers, headed by W. L. Child of Houston, Tex. The reports outlined the importance of the oil industry in the national defense picture and requested allocation of steel and other essential materials so as to permit the industry not only to maintain production but also to continue exploration and drilling. Under the priorities division's preference rating order P-22 as amended and broadened October 16, the requirements of the industry have been recognized to the extent of a blanket A-10 rating covering plants and their equipment used in petroleum production, refining and transportation, and in discovery, development and depletion of petroleum pools. In addition the recent conservation order of the OPM, imposing rigid controls on the use of copper and brass, includes, among its seven defense exceptions, the use of copper in oil refineries where corrosive action invalidates the use of other materials. Under the plan now approved by the OPM and the Petroleum Coordinator and designed to help both operator and supplier in obtaining materials needed to assure an adequate supply of petroleum and petroleum products, "most current needs can be satisfied through the use of the new PD-1 form," the Coordinator's Office pointed out. "All persons connected with the petroleum industry," it was added, "should become acquainted with this form as soon as possible. For example, a producer may need casing for a well to be drilled; he may require new tanks and separators for additional wells; he may need a pump; a refinery may need a new compressor or a pipeline a new pumping unit. The supplier in turn may need these materials for distribution to the operator." In all such cases a priority rating may be obtained by completing a PD-1 form for transmittal to the Office of Petroleum Coordinator in any one of its districts or regions. The declaration constitutes legal use of the rating.

When properly made, it has been emphasized, the form will constitute an accurate presentation of the applicant's needs and permit the OPC to recommend the rating to OPM. So important is it that the PD-1 be properly completed that the Coordinator's office has enumerated the following specific points for the attention of the applicant: (1) A description of the material should be given similar to the description on a purchase order, i. e., the generally understood and acceptable description ordinarily used in the trade; (2) Be sure to state cost of material; (3) Delivery dates must be shown so that the needed material will be supplied when it is to be used and not before; (4) The name of only one supplier should be shown. The name of the producer or manufacturer of the material can be given as the supplier if the name of the supply house, through which the material is to be delivered, is added. The order number should be the supply house's order number and not the pur-

OFFICE OF PRODUCTION MANAGEMENT
PRIORITIES DIVISION
WASHINGTON, D. C.

No. ..... (PRODUCER NUMBER)

ORIGINAL

APPLICATION FOR PREFERENCE RATING

Sheet One (page 1 of 4)

Instructions.—Applicant must be the user of the material, equipment, or service, excluding labor, hereinafter called "material." A separate application must be filed for each case presented. "Each case" means each need for specific material which can be filled by a single Supplier and which is for use in completing a specific contract (except as may be set forth in Par. 4 b). Thus, separate orders with a Supplier may be covered by a single application, if the material on each order is similar and for use in completing the same covering contract(s). All information deemed relevant by placed with several Suppliers, a separate application must be filed for each Supplier. If orders for identical material are the Applicant should be included in the application form; if space does not so permit, a supplemental typewritten statement may be attached. APPLICANT WILL RETAIN QUINTUPLICATE, AND SUBMIT COMPLETED APPLICATION IN QUADRUPLICATE TO DIRECTOR OF PRIORITIES, OFFICE OF PRODUCTION MANAGEMENT, WASHINGTON, D. C. PLEASE USE TYPEWRITER.

Date October 1, 1941.

1. John Doe Oil Company, (LEGAL NAME OF APPLICANT)
121 - South 3rd Street, Tulsa Okla, (ADDRESS)
Apache Field, Caddo County, Oklahoma, (ADDRESS OF PLANTS IN WHICH MATERIAL IS TO BE USED)

hereby requests issuance of a Preference Rating on the following material valued at $ 6,780.00 (Promised Delivery Date(s))

Item No.	Name and Description of Material
1	6000 feet 7" O.D. 20 lbs. Grade H-40 Range 2, Seamless Steel Casing.
2	6000 " 2½" 6.50 lbs. Grade H-40 Range 2, Seamless Steel Tubing.
3	
4	
5	
6	

*REQUIRED DELIVERY SCHEDULE	1st Delivery *Date	2d Delivery *Date	3d Delivery *Date	4th Delivery *Date	5th Delivery *Date	6th Delivery *Date	7th Delivery *Date	8th Delivery *Date
ITEM 1	12/1/41	12/20/41						
Unit Quantities	3000	3000						
ITEM 2	12/1/41	12/20/41						
Unit Quantities	3000	3000						
ITEM 3								
Unit Quantities								
ITEM 4								
Unit Quantities								
ITEM 5								
Unit Quantities								
ITEM 6								
Unit Quantities								

order for which has been placed by Applicant with: (If order not placed, check here ☐ and explain why under Par. 6c.)

2. Richard Roe Steel Co. (Delivered through Alpha Bee Supply Co.)
(NAME OF SUPPLIER ON WHOM PREFERENCE RATING IS REQUESTED)

Supplier's address Pittsburg, Penna. (Ardmore, Oklahoma)
(Alpha Bee Co. Order No.)

Applicant's Order No. 1072 Dated Sept. 21, 1941.

*Delivery Dates are arrival dates of material at Purchaser's Plant. Installment deliveries must be scheduled when partial deliveries will meet requirements. If necessary, delivery schedule may be attached as a part hereof

Sheet One (page 2 of 4)

3. If Applicant has pending, or intends to file application for other material for the same product or use for which the material specified in Par. 1 is required, list for each such application:

Name of Supplier	Name and Description of Material	Date of Application
Carnegie Steel	400 Feet 10 3/4" OD - 40.5 lbs. Seamless	PD-1 Sept. 27, 1941.

4. *a.* Supply the following information with respect to the product in which the material specified in Par. 1 will be used:

Name and Description of Product	Unit Quantities	Approx. Value	Delivery Date(s) scheduled in Contract(s) or Order(s)	% of Completion of Contract(s) or Order(s) specified in 4 b
This material is to be used in two wells, one to be drilled in SW-NW-NW section 2-5N-12W, and the other in SW-SW-NW section 2-5N-12W, Caddo County, Okla.		$48,000	12/1/42	First well to be started 11/8/42
			1/1/42	Second well to be started 12/10/42

If Preference Rating has been assigned to the product specified in 4 *a*, state Preference Rating None Certificate No.(s) None Unit quantities None

b. Identify contract(s) or order(s) for the product specified in 4 *a*: None

(1) If Applicant's customer is a governmental agency, state: Supply Arm or Bureau None Contract No. None (COMPLETE NUMBER)

(2) If Applicant's customer is not a government agency, state: Name Address

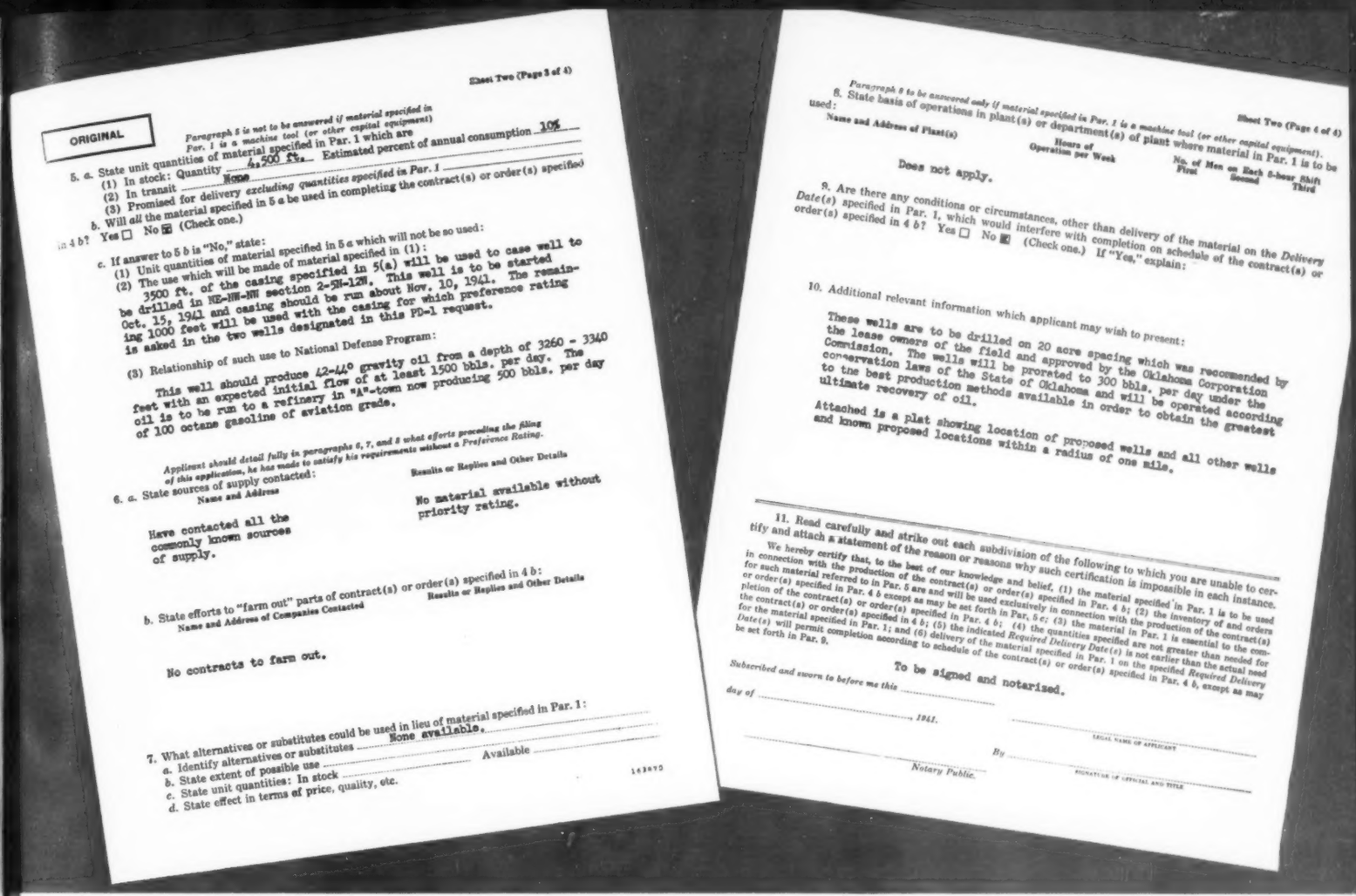
Customer's Order No. Date of order

*If numerous contracts or orders are involved, a Summary, making distinction between government and civilian orders, will suffice in lieu of answers to 4 b (1) and 4 b (2).

*SUMMARY:

This well is being drilled by John Jones Drilling Co. of Oklahoma City, Okla. The materials to be used in the well are being furnished by the applicant.

c. Explain how the material specified in Par. 1 (or its ultimate use) is deemed essential to the National Defense Program. If not essential to the National Defense Program, state why application is being made: Production is expected from the Simpson Sand reached at a depth of 3270 feet which in this field will have an estimated ultimate yield of 22,000 bbls. per acre. Offset wells take approximately 60 feet of saturated sand and report initial productions ranging from 1600 to 5000 bbls. per day. Oil is high gravity, 42° - 44°, and is being run to XYZ refinery in A-town which is now producing about 500 bbls. a day of 100 octane gasoline.



Sheet Two (Page 3 of 4)

ORIGINAL

Paragraph 5 is not to be answered if material specified in Par. 1 is a machine tool (or other capital equipment)

5. a. State unit quantities of material specified in Par. 1 which are
(1) In stock: Quantity None Estimated percent of annual consumption 10%
(2) In transit
(3) Promised for delivery *excluding quantities specified in Par. 1*
b. Will *all* the material specified in 5 *a* be used in completing the contract(s) or order(s) specified in 4 *b*? Yes ☐ No ☒ (Check one.)
c. If answer to 5 *b* is "No," state:
(1) Unit quantities of material specified in 5 *a* which will not be so used:
(2) The use which will be made of material specified in (1):

4,500 ft.

The use which will be made of material specified in 5(a) will be used to case well to be drilled in NE-NW-NW section 2-5N-12W. This well is to be started 3500 ft. of the casing specified in 5(a) will be run about Nov. 10, 1941. The remaining 1000 feet will be used with the casing for which preference rating Oct. 15, 1941 and casing should be rated AA-1 is asked in the two wells designated in this PD-1 request.

(3) Relationship of such use to National Defense Program:

This well should produce 42-44° gravity oil from a depth of 3260 - 3340 feet with an expected initial flow of at least 1500 bbls. per day. The oil is to be run to a refinery in "A"-town now producing 500 bbls. per day of 100 octane gasoline of aviation grade.

Applicant should detail fully in paragraphs 6, 7, and 8 what efforts preceding the filing of this application, he has made to satisfy his requirements without a Preference Rating.

6. a. State sources of supply contacted:

Name and Address	Results or Replies and Other Details
Have contacted all the commonly known sources of supply.	No material available without priority rating.

b. State efforts to "farm out" parts of contract(s) or order(s) specified in 4 *b*:

Name and Address of Companies Contacted	Results or Replies and Other Details
No contracts to farm out.	

7. What alternatives or substitutes could be used in lieu of material specified in Par. 1:
a. Identify alternatives or substitutes None available.
b. State extent of possible use
c. State unit quantities: In stock Available
d. State effect in terms of price, quality, etc.

143875

Sheet Two (Page 4 of 4)

Paragraph 8 to be answered only if material specified in Par. 1 is a machine tool (or other capital equipment).

8. State basis of operations in plant(s) or department(s) of plant where material in Par. 1 is to be used:

Name and Address of Plant(s)	Hours of Operation per Week	No. of Men on Each 8-hour Shift: First / Second / Third
Does not apply.		

9. Are there any conditions or circumstances, other than delivery of the material on the *Delivery Date(s)* specified in Par. 1, which would interfere with completion on schedule of the contract(s) or order(s) specified in 4 *b*? Yes ☐ No ☒ (Check one.) If "Yes," explain:

10. Additional relevant information which applicant may wish to present:

These wells are to be drilled on 20 acre spacing which was recommended by the lease owners of the field and approved by the Oklahoma Corporation Commission. The wells will be prorated to 300 bbls. per day under the conservation laws of the State of Oklahoma and will be operated according to the best production methods available in order to obtain the greatest ultimate recovery of oil.

Attached is a plat showing location of proposed wells and all other wells and known proposed locations within a radius of one mile.

11. Read carefully and strike out each subdivision of the following to which you are unable to certify and attach a statement of the reason or reasons why such certification is impossible in each instance.

We hereby certify that, to the best of our knowledge and belief, (1) the material specified in Par. 1 is to be used in connection with the production of the contract(s) or order(s) specified in Par. 4 *b*; (2) the inventory of and orders for such material referred to in Par. 5 are and will be used exclusively in connection with the production of the contract(s) or order(s) specified in Par. 4 *b* except as may be set forth in Par. 5 *c*; (3) the material in Par. 1 is essential to the completion of the contract(s) or order(s) specified in Par. 4 *b*; (4) the quantities specified are not greater than needed for the contract(s) or order(s) specified in Par. 4 *b*; (5) the material specified in Par. 1 on the specified *Required Delivery Date(s)* is not earlier than the actual need for the material specified in Par. 1; and (6) delivery of the material specified in Par. 1 on the specified *Required Delivery Date(s)* will permit completion according to schedule of the contract(s) or order(s) specified in Par. 4 *b*, except as may be set forth in Par. 9.

To be signed and notarized.

Subscribed and sworn to before me this ..... *day of* ....., *1941.*

LEGAL NAME OF APPLICANT

By .....

SIGNATURE OF OFFICIAL AND TITLE

Notary Public.

chaser-user's order number; (5) State how material is to be used. If information can be shown by plat, it would be advisable to do so. When the material is to be used in a well or wells, furnish plat of location and enough of surrounding area to show spacing pattern. Plat should indicate, with appropriate symbols, all wells on the lease or leases in question, and also on the offsetting leases. The well symbols used should identify specifically: (a) locations. (b) drilling wells, and (c) producing wells; (6) State specifically how the use of the material is essential to national defense. A general statement such as, "Petroleum is essential to National Defense," is unsatisfactory. Show what results are actually expected from the use of the necessary scarce material; (7) The inventory of the requested material must be shown. This inventory must include all the material owned by the parent company or any of its subsidiaries, and all material on which the company has any right or option to claim ownership. Under this heading must be included all the requested material which can be regarded as being owned by the company no matter where it may be located; (8) Notarize four copies and mail them to the Office of Petroleum Coordinator. The fifth copy is to be retained for your files; (9) Announcement was made on October 1 by the Director of Priorities of the Office of Production Management that those who use PD-1 forms may reproduce such forms if convenient and desired. The announcement stated that, "Anyone, who reproduces Form PD-1 must, however, follow exactly the phraseology, the size, the format, and the color of the official blanks furnished by the Division of Priorities."

A model form of application prepared as a guide for the use of oil men is reproduced on these pages.

Numerous supplementary orders have been issued defining such terms as "Repairs," "Maintenance" and "Operating Supplies" and explaining the procedure to be followed in exceptional cases. One of these supplements deals with emergency requests on which telegraphic action may be obtained if necessary providing information is supplied as to the date, location and cause of the emergency, the exact equipment needed and the name of the supplier from whom it is to be obtained. In the case of a new project requiring special rating a "prospectus" of the undertaking must be submitted, four copies of this outline going to the [illegible]nment and one being retained by the applica[illegible]. A drilling program, construction of refining plants or units, a cycling or repressuring plant or a pipeline comes under this classification. The application should include detailed plans, describe the purpose of the undertaking, list the materials involved, state costs and give the delivery schedule required as well as a description of its bearing on national defense.

Although the formal details of procedure have been worked out there apparently is still some duplication of activity as between the Coordinator's office and the OPM. Mr. Nelson, testifying before the House Banking and Currency committee on the price control bill, indicated that the OPM was arranging with the governors of the various states to appoint representatives to handle repair and inventory priorities directly. The Petroleum Coordinator's office meanwhile has sought to act as the initial clearing point for petroleum industry priorities. The Coordinator's office also is stressing the importance of material for exploration and development operations. In a recent address Robert E. Allen, director of production pointed out that the important lesson learned by the oil industry during the World War was the absolute necessity of having an adequate reserve of productive capacity to prevent the oil fields of the nation from being subjected to an "injurious or wasteful" rate of production to meet emergency demands. Referring to the urgency of this phase of petroleum operations he said: "In the face of (1) a declining indicated years' supply of known reserves, (2) a likely ever increasing demand for domestic crude as a result of the probable necessity of meeting, from domestic supply the defense, industrial and civilian needs of other countries as well as our own, and (3) an increasingly difficult discovery problem, it seems clear that exploration must be pressed with intensity."

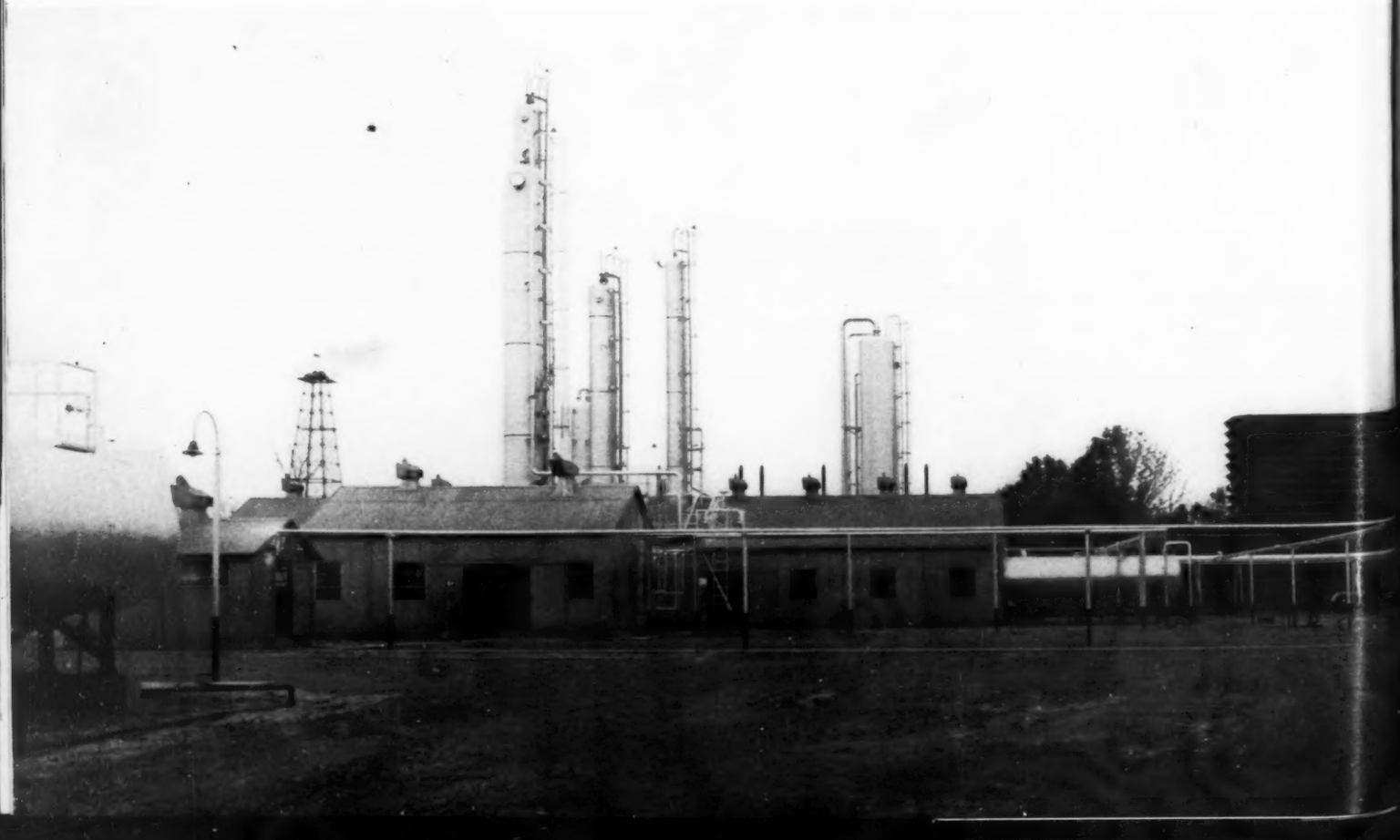
EFFICIENT GASOLINE PRODUCTION

DIVERSION of oil tankers to Britain and Russia and the threatened gasoline shortage in the eastern states, has caused oil fields and gasoline plants nearest the east, particularly those that ship their product by rail, to take on increased importance. Newest of the gasoline plants in the Centralia-Salem field of Southern Illinois is the Warren Petroleum Corporation's stripping plant in the northwest section of the field, just six miles from Salem. Handling 18,000,000 cu. ft. of casing-head gas gathered from 571 wells during each 24-hour period, the plant has recorded a daily production of 950 bbl. of gasoline, 20,000 gallons of butane, and 10,000 gallons of propane. The principal power job of compressing the incoming gas from a suction vacuum of nine inches to a discharge pressure of 40 pounds is accomplished by five 400-hp. Clark gas engine-compressor units of the modern angle type illustrated on the facing page.

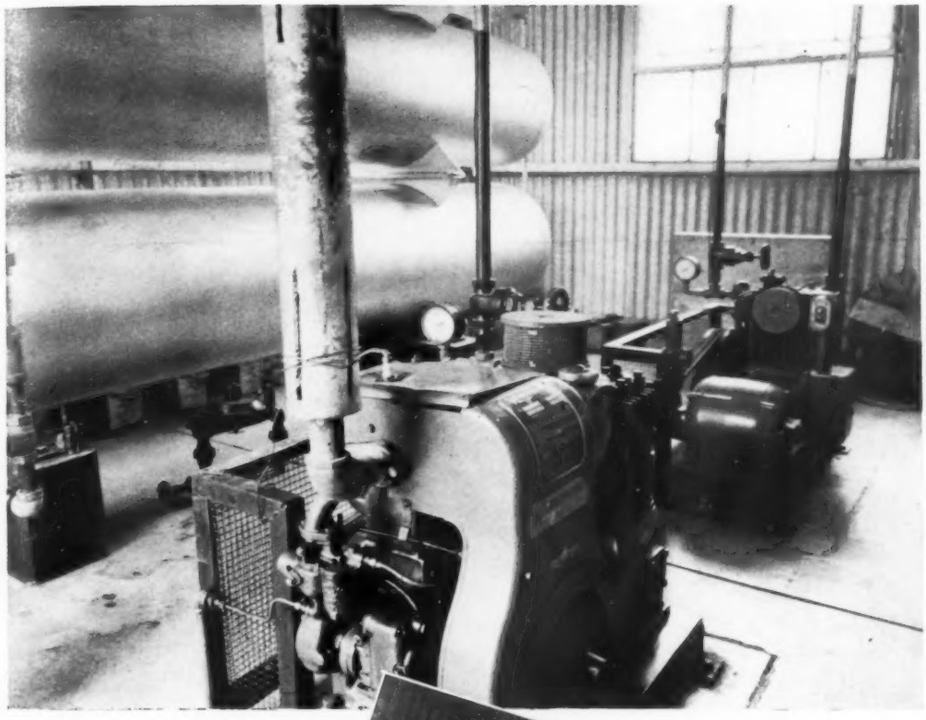
Gas comes from the field through two gathering systems with a scrubber for each, to a 20-in. header connecting the two scrubbers. An individual 16-in line carries gas from the buried header to each of the compressor cylinders in the plant. In effect, the angle compressor unit is a vertical gas engine driving horizontal compressor cylinders attached to a common crankshaft. Of the five, four-cylinder, 400-hp. engines in the plant, four drive two, 27 by 14-in., compressor cylinders each. The fifth engine drives two, 23 by 14-in., cylinders and a 10½ by 14-in., recompressor cylinder. The recompressor handles gas from the gasoline receiver tank, receiving it at 50 lbs. and discharging it at 200 lbs. pressure to a scrubber and stabilizer. Three factors promote the economy of this power installation: first, the efficiency of the gas engine; second, elimination of loss in power transmission accomplished by the common crankshaft of the angle design; and third, the fact that denuded residue gas can be used as fuel. Gas from the residue line reaches the plant at approximately 20 lbs. pressure, passes through a regulator which reduces the pressure to 15 lbs., then enters an underground header at the back of the plant with a line to each engine. Gas enters each power cylinder at this pressure just after the exhaust ports have been closed on the compression stroke of the two-stroke cycle. Timely ignition is assured by a rotary magneto for each engine. Exhaust gases from each two power cylinders enter a common pipe and vent through a snubber extending vertically up through the roof. Intake air for each engine enters through an individual, impingement-type, air filter located just outside the plant.

All bearings are lubricated by oil under pressure, and pistons are cooled by the same supply of lubricating oil. Oil is drawn from the crankcase by a gear pump on the end of the crankshaft and is sent through a battery of five filters and a cooler before reaching the header that supplies the bearings. A mechanical, force-feed lubricator supplies oil to both power and compressor cylinders. To clean the crankcase oil, an activated clay reclaimer has been provided. This is arranged for by-pass operation on one engine at a time, taking oil from the discharge line of the main engine circulating pump and returning it after purification to the crankcase. This reclaimer serves each unit for a month, then is disconnected and moved over to the next engine on the line. Only steam condensate is used in the engine cooling system. To circulate this jacket water, each engine has a centrifugal pump driven by four V-belts from a pulley just outside the flywheel. Water is pumped through cylinder jackets and through one section of the large atmospheric-type cooling tower, 197 ft. long, 24 ft. 4 in. wide and 48 ft. 6 in. high, that serves all cooling needs of the entire gasoline plant. Raw water from the 1700 bbl. concrete sump of the cooling tower, is pumped over the tower by two 2500 g.p.m. centrifugal pumps driven directly by two 40-hp. Buda natural gas engines. Makeup water is obtained from the Kaskaskia River, 20 miles to the west. In the event of pump failure,

General view of Warren Petroleum's gasoline plant showing the pump house, the power house, stabilizers, still and absorbers, and the cooling tower.



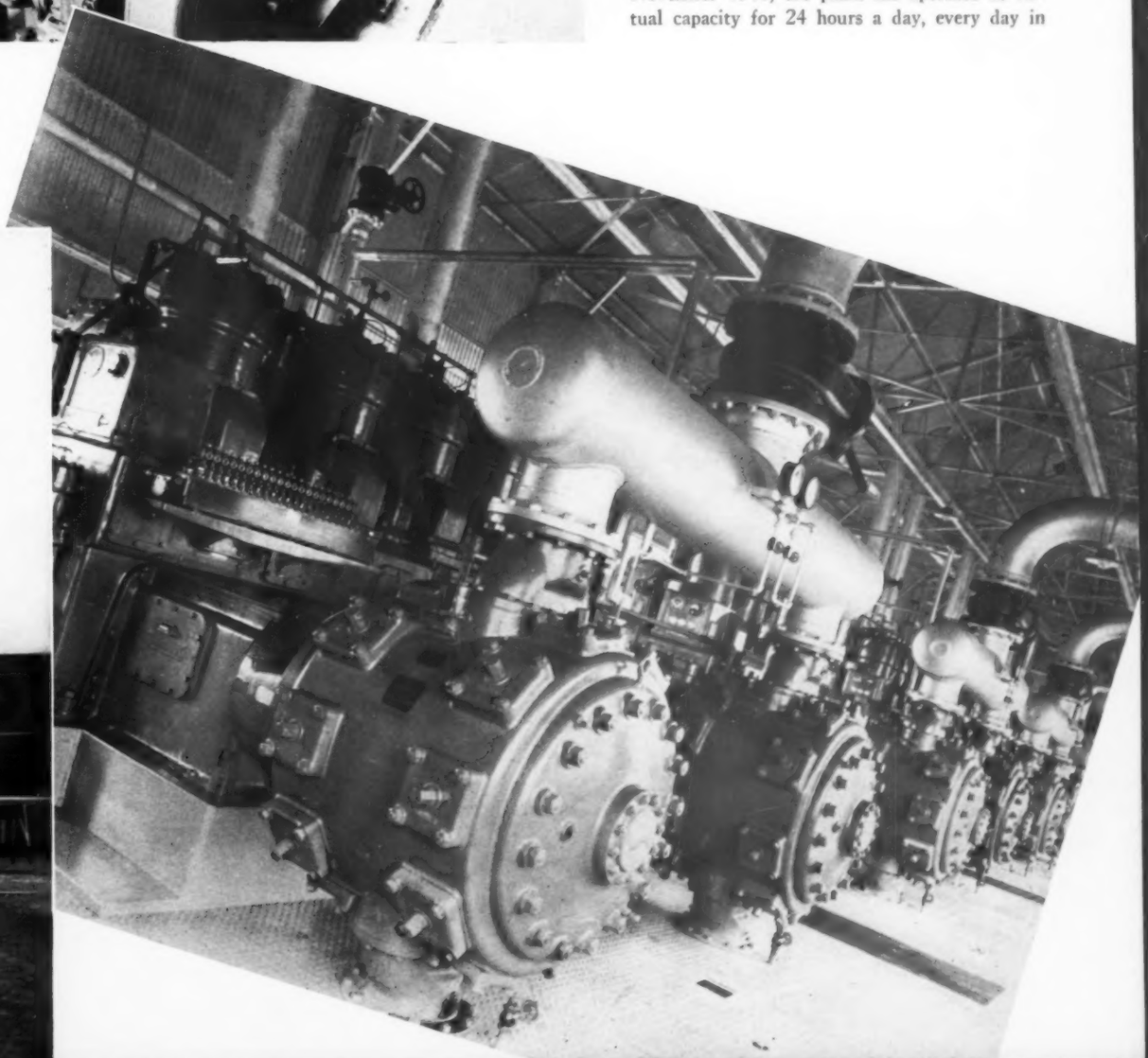
FROM ILLINOIS FIELD



Gasoline Plant of Warren Petroleum in Centralia-Salem Field Produces 1,000 Bbl. of Gasoline, 20,000 Gallons of Butane and 10,000 Gallons of Propane Per Day.

By William H. Gottlieb

Above, compressors supplying air for starting the engines: Right, Clark Brothers engine compressors totaling 2.000 h.p. and handling 18 million cubic feet of casinghead gas each 24 hours.

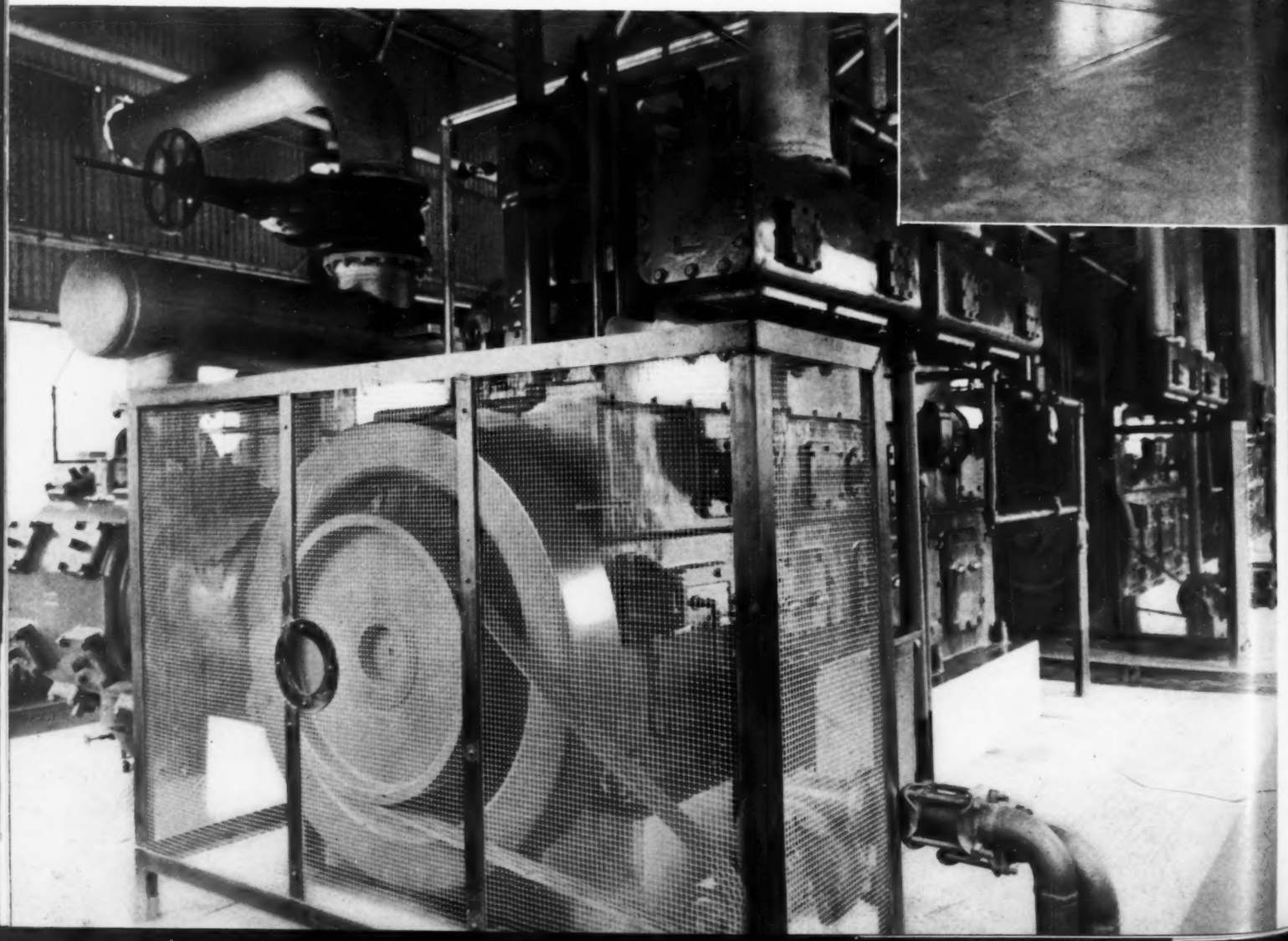


water can be sprayed over the tower by an emergency gas-lift system to insure cooling.

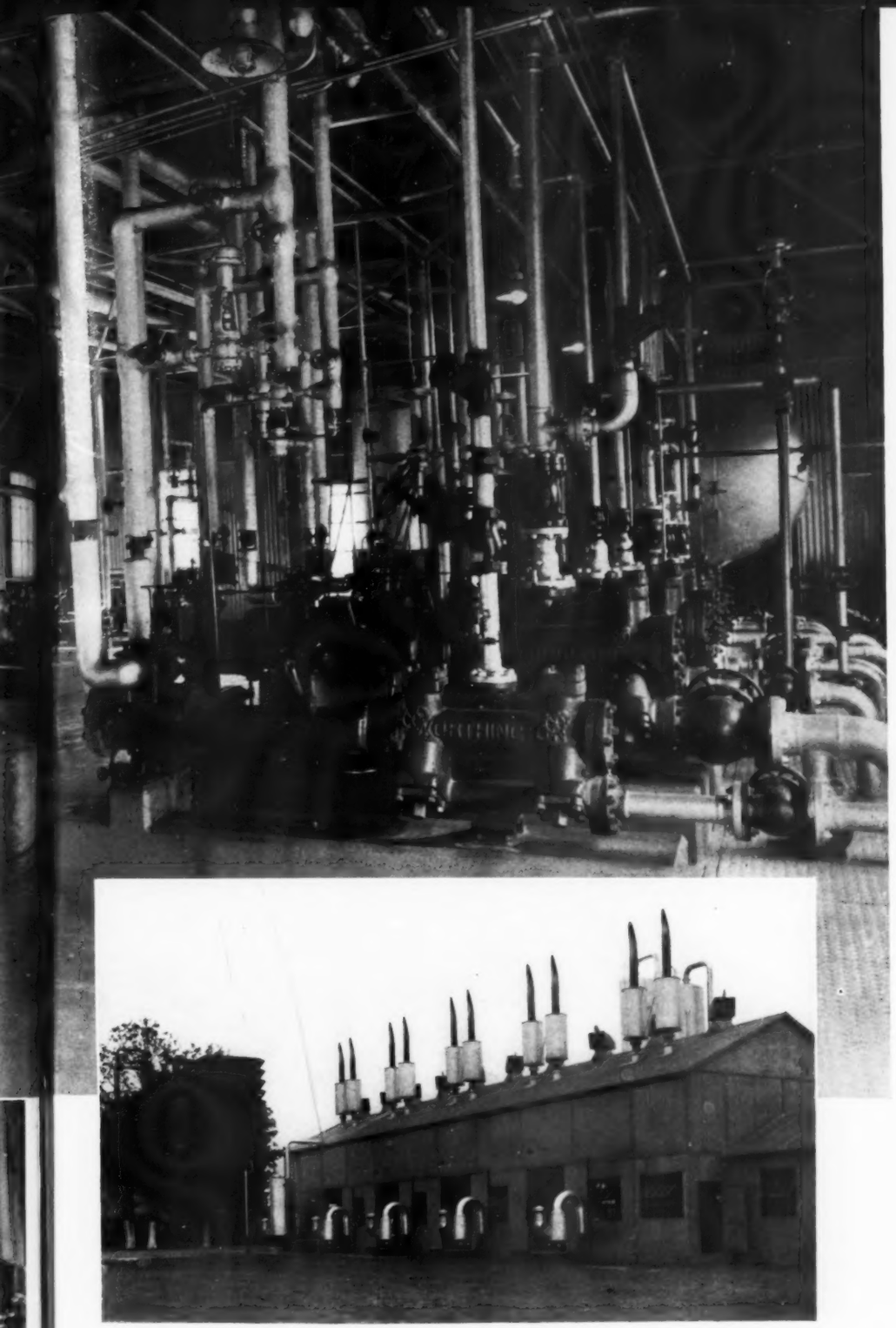
Continuity of operation is second only to safety in oil field operations of this nature. Since the 2000-hp. of the power plant was put to work in November 1940, the plant has operated at virtual capacity for 24 hours a day, every day in

the week. For such successful continuity of operation, engine conditions must be right. A gauge board on the end of each engine permits the operator to tell at a glance lubricating oil pressure and intake and outlet water temperatures. Oil pressure is kept at 30 lbs. Water enters the engine jackets at 160 deg. and leaves at 180 deg. A multi-point pyrometer on the gauge board allows a quick check on exhaust temperature at each cylinder. Even if the operator fails to catch an unhealthy condition, adequate safety devices have been provided to eliminate the possibility of serious damage. If lube oil pressure drops too low or cooling water temperature rises too high, the magneto of each engine affected is grounded automatically. In addition there is a master switch outside the plant so that the operator can ground all the magnetos and stop the engines without entering the plant in case of a gas leak or fire. Engines are started by compressed air provided by two compressors, one driven by an electric motor and one by a gasoline engine. Steam is required in many of the gasoline plant's operations and is used, also, to drive most of the pumps. For this dual purpose, the plant contains six, 125-hp. Kewanee Oil Country type, gas-fired boilers which generate steam at 250 lbs. per sq. in. The system is designed to use exhaust steam from the reciprocating pumps for process and to return as much condensed steam to the boilers as possible. The stabilizer charge and reflux pumps operate at full line pressure and exhaust at 50 lbs. Steam from this exhaust header is dried and heated in an exchanger by 250 lb. steam and then used for open steam in the still. Fifty pound steam from the same header is used in the reboilers of the second and third stabilizers. Turbines driving the rich and lean oil pumps exhaust at 15 lbs. and this steam is used in the fourth stabilizer's reboiler for boiler feed water and for building heating. Condensate from the still preheater is returned to the boiler feed line by a simplex pump while condensate from the dehydrator tray of the still passes through a separator to the boiler feed tank. Two simplex pumps supply heated feed water to the boilers.

Oil men will be interested in a somewhat more detailed outline of the gasoline plant set-up. After the entering gas is compressed to 40 lbs. and cooled in two sections of the tower, it passes through a 6 by 10-ft. scrubber to two, 7 by 54-ft. 20-tray absorbers. Rich oil from the absorber is sent by a turbine-driven centrifugal pump through



Below, water jacket pumps and clarifier such as are used on all engines in the plant: Right, complex pumping needs of the gasoline plant are handled by the turbine driven centrifugal pumps at left and the reciprocating pumps at right.



Power house of the Warren Petroleum plant housing the 2000 h.p. of Clark Brothers gas engine angle compressors.

tubes of a rich oil-lean oil heat exchanger and then through a steam preheater to the still. After stripping, the oil, now lean, passes through the shell of the same exchanger to a 3 by 12-ft. horizontal, surge tank. A turbine-driven centrifugal pump forces the oil through six sections of the cooling tower and then back to the absorbers. Residue gas from the absorber passes through a scrubber to a 12-in. distributing header from which it enters the plant supply line, three 6-in. field fuel lines, and an 8-in. line to the City of Salem where the gas is used for domestic purposes. It is residue gas, of course, that is used for engine fuel in the power house. The still has 16 operating bubble trays, a blank dehydrator tray and a mist extractor. Overhead vapors are condensed in three sections of the cooling tower and then flow to a reflux tank from which reflux for the still is drawn by two duplex pumps. The gasoline product and vapors pass from the top of the tank through a section of the cooling tower to a 7 by 30-ft. gasoline receiver. Uncondensed gases in the gasoline receiver pass through a 3 by 10-ft. scrubber to the recompressor cylinder of one of the engines. The gases are compressed to 200 lbs., cooled and then delivered to a 3 by 10-ft. scrubber. Condensate is pumped from this scrubber by a simplex pump to the second stabilizer while vapors are released to the residue gas header. Raw gasoline in the receiver is pumped through a heat exchanger to the first stabilizer by a simplex pump. This 4-ft. 6 in. by 66-ft. tower has 50 trays, and bottom heat is supplied by a reboiler using 250 lbs. steam. Overhead in this stabilizer is condensed and used entirely for reflux which is handled by a simplex pump. Non-condensible gases in the reflux accumulator, mostly ethane, are released to the residue gas header. The bottom product exchanges heat with the charge, is cooled in two sections of the cooling tower and then passes to the treatment plant.

The de-ethanized gasoline is mixed with a 10 degree caustic solution in a 5 by 16-ft. tank with a motor-driven centrifugal pump to circulate the mixture. The gasoline then passes through a 5 by 25-ft. horizontal settling tank and a 5 by 14-ft. sand filter to two 5 by 12-ft. reagent towers. Treated gasoline passes through a heat exchanger to the second stabilizer, a 4 by 55-ft. tower with 30 trays and a steam reboiler. The bottom product is natural gasoline stabilized to the desired vapor pressure and this product exchanges heat with the incoming charge and passes through a section of the cooling tower to a storage tank. The overhead, a propane-butane mixture, is condensed in a section of the cooling tower. Reflux is handled by a simplex pump. Excess reflux from this stabilizer is sent by a simplex pump through a heat exchanger to the third stabilizer, a 3 by 16-ft. tower with 30 trays. The overhead product is dehydrated in a tank containing calcium chloride and then goes to storage as commercial propane. A steam reboiler provides bottom heat for this stabilizer and a simplex pump is used to handle reflux. The bottom product of the third stabilizer is a mixture of iso and normal butane, and passes through a heat exchanger to the fourth stabilizer, a 4 by 85-ft. tower with 50 trays and a steam reboiler. The overhead is condensed in a cooling tower section and used for reflux which is handled by a simplex pump. Excess reflux is stored as iso butane. The bottom product exchanges heat with the incoming charge, is cooled in a section of the cooling tower and passes to normal butane storage. Non-condensible gases from the reflux accumulators of all four stabilizers are released to the residue gas header to be used as plant fuel or piped to Salem for domestic use.

There are ten 10 by 40-ft. horizontal tanks for gasoline storage, four 10 by 40-ft. horizontal tanks for butane storage, and one 7 by 30-ft. and two 7 by 40-ft. horizontal tanks for propane storage. Gasoline is pumped to a 10-car loading rack on the Missouri and Illinois Railroad near the plant, by a 300 gallon per minute motor-driven, centrifugal pump. A simplex pump delivers butane and propane either to the loading rack or to a truck-loading dock.

Rowan & Nichols Decision of Great Significance in Oil Conservation Law Interpretation

By Leslie Moses
Attorney
Fohs Oil Co.

"ALTHOUGH the law, in one sense, exists only in the minds of lawyers and judges, it is in fact, an expression of the rules of conduct and relationship growing out of the social conscience. As society and its needs change and grow, so inevitably must the law change and grow. The last decade has witnessed change and growth in many branches of the law. Not the least to be affected have been administrative law and oil and gas law. It is probable that neither has come of age, but certainly both are in a vibrant state of noisy, adolescent, indecision. Administrative law has grown in almost the same ratio as the public payroll and the tax bill, and in some respects, has become almost as terrifying. Oil and gas law has been in the same fluid state as the subject matter with which it deals."

A more fitting preface to this article than the foregoing quotation from an address by Roy W. Johns, General Counsel, The Atlantic Refining Company, before the Minerals Section of the American Bar Association, 1940, could not be found. The law of oil and gas, as developed in the last seventy-five years in the United States, is a law peculiar unto itself. This peculiarity is the outgrowth of the unfamiliarity of the courts with the subject they had under consideration, and this unfamiliarity was not with principles of law that might be applicable to controversies that came before them, but with physical and economic peculiarities of oil and gas itself. Because of the fact that courts were inclined to draw analogies between oil and gas and other physical substances whose legal status had already been determined by them, the results were sometimes startling and subsequently difficult.

The fugacious nature of oil has lead to the analogizing of the substance to wild animals, *ferae naturae*. In 1889, in Westmoreland & Cambria Gas Co. v. Dewitt (18 Atl. 724), the Court said: "Water and oil, and still more strongly, gas, may be classed by themselves, if the analogy be not too fanciful, as minerals *ferae naturae*. In common with animals, and unlike other minerals, they have the power and the tendency to escape without the volition of the owner. Their 'fugative and wandering existence within the limits of a particular tract was uncertain,' as said by Chief Justice Agnew in Brown v. Vandergrift, 80 pa. St. 147, 148. They belong to the owner of the land and are a part of it, so long as they are on it or in it, and are subject to his control, but when they escape and go into other land, the title of the former owner is gone. Possession of the land, therefore, is not necessarily possession of the gas. If an adjoining or even a distant owner drills on his land, and taps your gas, so that it comes into his well and under his control, it is not longer yours but his."

The old English rule of percolating waters was even invoked in one instance. These comparisons led to the establishment of a doctrine now firmly embedded in American oil and gas law, a doctrine unique to this law and to this industry alone; The Rule of Capture.

The inception of the phrase "Rule of Capture" is unknown. Pennsylvania decisions are referred to as having laid down the doctrine. There is no agreement as to exactly which case did lay down the rule, but there is agreement, however, that in the two cases to which most persons attribute such origin, the language setting forth the doctrine is purely dicta. Neither decision, on its facts, sustains the privilege of draining from another's land. It is also certain that in neither of the cases the phraseology "Rule of Capture" nor language giving rise to such a phrase is used. As early as 1875, in Brown v. Vandergrift, 80 Pa., 147 it was said: "The discovery of petroleum led to new forms of leasing land. Its fugative and wandering existence within the limits of the particular tract is uncertain, and assumes certainty only by actual development found upon expirement."

Some contend that this was the beginning of such theory. However, the majority attribute the doctrine to the Westmoreland Gas case. Summers in his recent work on Oil and Gas states that the doctrine "has been recently referred to as the law of capture." It is, however, certain that out of conditions arising in the Pennsylvania oil fields during the latter part of the nineteenth century came certain legal principles which, in their main tendency, have promoted the rule of

capture. The first of such principles was the theory that leases on prospective oil lands were taken primarily for development, and not for delay. The second was that oil leases had to be construed strictly against the lessee. The third was the doctrine of implied covenants. In 1866, in Funk v. Haldeman, 53 Pa. 229 it was contended: "Oil is not the subject of grant as a corporeal heriditament. It is a movable, wandering, fugative thing in the bowels of the earth, and must of necessity continue common like water, so that one can only have a usufructuary property interest therein."

In view of the analogy of oil and gas to wild animals, and the like, therefore, the courts recognized the right of a landowner to take and keep, from a common reservoir, as much of the oil and gas therein as he could. This was recognized by the Supreme Court of the United States, in 1895, when it said: "Petroleum, gas and oil are substances of a peculiar character, and decisions in ordinary cases of mining, for coal and other minerals which have a fixed status, cannot be applied to contracts concerning them without some qualification. They belong to the owner of the land, and are part of it, so long as they are on it or in it, or are subject to his control, but when they escape and go into other land, or come under another's control, the title of the former owner is gone. If an adjoining owner drills his own land and taps a deposit of oil or gas, extending under his neighbor's field, so that it comes into his well, it becomes his property." (Brown vs. Spillman, 155 U. S. 665).

What then could the adjoining owner do: The Supreme Court of Pennsylvania, in 1907, answered that question thusly: "The right of every landowner to drill a well on his own land at whatever spot he may see fit certainly must be conceded. He may crowd the adjoining farm so as to enable him to draw oil and gas from them. What then can his neighbor do? Nothing only go and do likewise. He knows it is wild and will run away if it finds an opening and it is his business to keep it at home. This may not be the best rule, but neither the legislature nor our highest courts has given us any better." (Bernard v. Monongahela Natural Gas Co., 216 Pa. 362, 65 Atl. 801).

Thus was the rule developed. Robert E. Hardwicke, Fort Worth attorney and a recognized authority on oil and gas law, has said in his monograph "The Rule of Capture and its Implications as Applied to Oil & Gas," 13 Texas Law Review 391 (1933): "The Rule of Capture may be stated as follows: The owner of a tract of land acquires title to the oil or gas which he produces from wells drilled thereon, though it may be proved that part of such oil or gas migrated from adjacent lands."

A natural outgrowth of the Rule of Capture is the "Offset Drilling Rule," of which Mr. Hardwicke writes: "An owner of land which is being drained by the operation of wells in neighboring lands cannot enjoin the further operation of the offending wells and cannot recover damages from the operation thereof, but must protect his lines as best he can by producing from offset wells drilled on his own lands." The anthithesis of the Rule of Capture is the "Ownership in Place Doctrine," defined by Hardwicke thusly: "The owner of a tract of land owns the oil and gas in place and, should minerals migrate to a neighbor's land and be produced from wells thereon, title would not vest in the neighbor but, to the contrary, the migrating oil or gas, or at least an amount equal to that which migrated, could be recovered by the true owner." This doctrine has been adopted by nine of the oil producing states; Arkansas, Kansas, Michigan, Mississippi, Ohio, Pennsylvania, Tennessee, Texas, and West Virginia, and the contrary doctrine, the "Non-Ownership Doctrine," upon which the Rule of Capture and the Offset Drilling Rule have been based, has been adopted by seven of the oil producing states; California, Illinois, Indiana, Kentucky, Louisiana, New York and Oklahoma.

This Non-Ownership Doctrine has sometimes been referred to as the Exclusive Rights Doctrine, because of the fact that the landowner, or his lessee, has the "exclusive right" to drill for oil or gas on his property and retain what he finds. The theory is, in other words, that in some states the landowner owns the oil and gas beneath his land before it is found and brought to the surface, while in other states the landowner owns only the right to reduce such oil and gas to possession. As a practical operating problem, however, this differentation has little effect on decisions of the courts. The Rule of Capture has been applied in every state, regardless of whether such state approved the Ownership in Place or the Non-Ownership Doctrine. The landowner had the right to drain oil and gas from the neighboring land, and to exhaust, if possible, the reservoir content through his own wells. These decisions have existed for such length of time that they have become established rules of property and judicial precedents which the courts invoke under the doctrine of stare decisis, i. e., the rule to maintain former holdings, to uphold precedents. During the past fifteen years or more, therefore, the oil industry has been struggling with legal problems which are the heritage of the early period of the industry's growth. In a recent monograph, "The Growth of Oil & Gas Conservation Statutes" (13 Mississippi Law Journal 353-1941), the writer has attempted to trace the growth, economically and historically, of conservation statutes enacted in more recent years. Development of the industry in the past decade has brought with it development of legislative restrictions aimed at conservation of the natural resources of the states. It is not the purpose of this article to attempt any exhaustive discussion of legal points involved in conservation, for such a discussion would be interesting only to lawyers particularly concerned with the detailed problems of the oil industry. It has been deemed advisable to proceed along more general lines of interest to the layman.

Early abuses and evils in the production of oil, which the leaders of the industry are endeavoring to cure, are too well known to justify enlargement here. The effect of early court decisions based upon those legal principles arising in the Pennsylvania oil fields in the latter part of the nineteenth century was to make legal the pumping of all of the oil and gas possible from every man's well. This resulted in the waste of valuable natural resources, and made it impossible to adopt any effective method of conservation. What remedial steps were necessary are also well known to those in the industry; conservation legislation came into being. The period from 1926 to 1930 furnishes the economic background for most of the conservation legislation enacted in recent years. The acceleration in discovery of new fields during that period provided the background for development of legislative restrictions upon a large scale, and most of such restrictions have been either upon drilling or upon production. Generally speaking, however, proration came into the limelight of legislative and judicial attention before the control of drilling.

A review of the cases involving conservation statutes has established the existance of two fundamental theories upon which the state may regulate the extraction of oil and gas. The first is the police power of the state, exercised in the public interest as a basis for the constitutionality of such a statute; the second is the correlative rights doctrine, insuring ratable taking from a common reservoir to protect the correlative rights of the common owners of the pool. There is indeed a third theory, to be mentioned here, concerning which more will be said later and that is that it is today becoming increasingly recognized that as our life changes, as our occupations become more intricate and as they become more integrated into each other, there are produced conditions not dreamed of years ago. Economic conditions are vastly different now than they were at the turn of the century. A life strikingly different from that earlier period has produced a great many different situations, which not only require, but which constitutionally justify, legislative action and regulation.

Section IX of the Bill of Rights provides that "the enumeration in the Constitution of certain rights shall not be construed to deny or disparage others retained by the people." In Section X it is provided that "the powers not delegated to the United States by the Constitution, nor prohibited by it to the States, are reserved to the States respectively, or to the people." Among the powers universally recognized as reserved to the state are the police powers of the state, and the power to regulate and control rights in the ownership of local property. Not unlike ordinary property rights, rights in oil and gas leases are subject to regulation and limitation by the police power of a state. Such exercise of police power

Early days of the Illinois Basin fields revival; no conservation was practiced in many fields leading to wastes of gas and reservoir energy.

has long been sanctioned and accepted as a matter of course. Police power is utilized to protect the general public welfare by conserving the natural resources, and to protect the correlative rights of the collective owners. While it is true that police power is usually invoked to sanction legislation designed to protect and promote public health, safety and welfare, the old maxim "Make use of your property in such a manner as not to injure that of another" justifies its invocation to impose limitations upon liberty and property at common law. Where the law does not protect the common property owners in the full enjoyment of their property, the police power of a state can be utilized by a specific act of the legislature for such purposes.

It is necessary, therefore, in this discussion, to refer to certain principles that were firmly imbedded in the constitutional law of the country as a result of cases where the police power of the state met and opposed the due process clause of the Fourteenth Amendment to the Constitution. In determining the scope of police power, local conditions must be taken into account. The determination of the local legislature and of the highest court of the state that the public policy of the state demands a police measure of a particular type will have great weight. Unless such legislation be manifestly unconstitutional it is usually upheld because of the familiarity of the local legislature and of the local courts with the needs of that particular jurisdiction. If mere locality is a circumstance which must be considered in determining the validity of a statute enacted to promote the social or economic betterment of the people, then certainly no other business known to American enterprise possesses to greater degree the quality of locality than does the business of producing oil. While quite a few of the states produce oil in small quantities, the chief dependence of the country is upon the supplies found in about eight of the states. It is in these states that the regulation of the business of producing oil assumes extraordinary importance. Regardless of the manner in which locality has been stressed, the fact remains that in no oil state is public opinion of the oil industry the controlling force in bringing about enactment of measures regulating that industry. It is true that the men in the industry, by reason of their training, experience and skill, have a molding effect upon the nature of regulations imposed. At the same time, the influential and persevering forces that lead to the regulation and control of the oil industry come from the state itself, and not from the industry. In the first place, practically every lease taken is executed by the farmers or ranchers of the state. Form these leases they receive bonuses, rentals and royalty. In every important oil producing state the industry hires more employees than any other enterprise or business. Indirectly, too, the industry gives employment to thousands of others. Money paid for leases finds its way into every channel of trade or commerce in the state. A large part of the state's revenue comes from production and severance taxes. In other ways taxable wealth of other kinds, directly connected with the industry, is brought into the state and becomes a source of revenue. When these circumstances are combined, it is evident that it is but natural that the oil producing states should do their utmost not only to encourage but also to prolong the productive life of the industry. State universities now have departments of petroleum engineering and geology and through these instrumentalities it has become a matter of state public policy to foster and encourage the business of producing oil, and to furnish it with technology necessary for its continued progress. In Barbier v. Connolly, 113 U. S. 27 (1885) the Supreme Court of the United States said that police power not only includes regulations to promote the health, peace, morals and good order of the people "but also the power to legislate so as to increase the industries of the state, develop its resources, and add to its wealth and prosperity."

It is correct, therefore, to state that in testing a statute based upon police power against the due process clause the public welfare of the people and the state is always the most important factor. Fundamentally private rights must yield to police power because the public welfare of the state so demands. The immunity of property rights under constitutional guaranties from the constantly expanding police power of the state is not a simple question and no court ever has laid down a specific and final rule which unerringly will draw the line between the two concepts. It is well settled that each case must be considered and decided upon its particular facts. It has already been pointed out that the determination of local legislatures have an important part in deciding a case.

One cannot ignore another rule of constitutional interpretation which is deeply imbedded in our law. I refer to a change in economic conditions which may lead to the upholding of a police measure where, under economic conditions previously obtaining, the measure would not be upheld. Very rationally it has been held that the scope of police power in contrast to due process depends upon conditions as they may change from time to time. A measure which would be held invalid in a state of society or under economic conditions previously existing might be held constitutional by change of circumstance or condition. In tracing the history of the various oil conservation statutes of the several states it must be remembered that the legislatures, in formulating measures for the benefit of the social and economic betterment of the people of the state, do not view the legislation as to immediate aspect or effect. It must look as far into the future as possible. It may be stated that where an act of a state legislature, passed under the police power of the state, is fairly debatable in relation to the due process clause of the Fourteenth Amendment, the statute will be upheld.

The state's power to legislate for protection of its natural resources, regardless of the theories advanced, is based essentially upon police power. Certain constitutional checks have been urged against the exercise of such police power, the most important being: Deprivation of property without due process of law; denial of equal protection of the laws; impairment of the obligation of a contract; and, interference with interstate commerce. Minor checks have been: Delegation of legislative authority to administrative bodies; and, price fixing characteristics. Mr. Justice Holmes, in Hudson County Water Co. v. McCarter, 209 U. S. 349, 1908, ably defined the "limits" of police power in saying: "All rights tend to declare themselves absolute to their logical extreme. Yet all in fact are limited by the neighborhood of principles of policy, which are other than those on which the particular right is founded, and which become strong enough to hold their own when a certain point is reached. The limits set to property by other public interests present themselves as a branch of what is called the police power of the state. The boundary at which the conflicting interests balance can not be determined by any general formula in advance, but points in the line, helping to establish it, are fixed by decisions that this or that concrete case falls on the nearer or farther side. For instance, the police power may limit the height of building in a city without compensation. To that extent it cuts down on what otherwise would be the height so far as to make an ordinary building lot wholly useless, the right of property would prevail over the public interest. and the police would need the compensation and the power of eminent domain."

The cases, all in all, indicate that the courts overwhelmingly recognize the responsibility, power and authority of the state to enact conservation legislation. In June 1940 the Supreme Court of the United States decided the Rowan & Nichols case (310 U. S. 573, opinion amended 311 U. S.) The question before the court was the validity under the Fourteenth Amendment of an oil proration order promulgated by the Railroad Commission of Texas. It has already been stated that it was not the purpose to include in these notes any exhaustive discussion of legal problems, but because of the possibly far reaching effect of this decision, it is necessary to make mention of certain enunciations of the court on points vital to the subject hereof.

In the original opinion certain language of Mr. Justice Frankfurter ably summed up the cause and effect of conservation legislation. The problem of regulating the oil industry is "as thorny a problem as has challenged the ingenuity and wisdom of legislatures. Partly to mitigate the undesirable consequences of unsystemized development, the oil producing states have enacted conservation laws with appropriate mechanisms to control drilling and production. But merely writing laws is only the beginning of the matter. The administration of these laws is full of perplexities. State agencies have encountered innumerable difficulties in trying to adjust the many conflicting interests which have grown out of the rule of capture and its implications. The experience of Texas illustrates that a brood of litigation almost inevitably follows the inherent empiricisms of these attempted solutions." He went on to say "A controversy like this always calls for a fresh reminder that courts must not substitute their notions of expediency and fairness for those which have guided the agencies to whom the formulation and execution of policy have been entrusted." And again Mr. Justice Frankfurter said: "It is not for the federal courts to supplant the Commission's judgment even in the face of convincing proof that a different result would have been better."

The court itself, in its amended opinion, explained its holding thus: "This adjustment by the state's expert agency of what in our former opinion we called 'as thorny a problem as has challenged the ingenuity and wisdom of the Legislatures' was attacked on two grounds. We rejected these arguments as an attempt to substitute a judicial judgment for the expert process invented by a state in the field so peculiarly dependent on specialized judgment. We said in effect that the basis of present knowledge touching proration was so uncertain and developing, that sounder foundations are only to be achieved through the fruitful empiricism of a continuous administrative process. Further, that it ought not to be stifled by drawing from the generalities of the Constitution allegiance to one as against another speculative assumption even though delusively clothed in formal findings of fact."

In commenting on the result of this language, Professor Summers said in an article, "The Rowan & Nichols Case" (13 Mississippi Law Journal 417-1941). "This statement, together with other language of the opinion, indicates that in neither the first nor second opinion is the court willing to go quite so far as to say that federal courts may no longer enjoin proration orders because they find them arbitrary or without a rational basis. It is clearly apparent, however, that the Court is declaring a policy to the effect that where a state is acting within its regulatory powers through an administrative agency of its creation, and such acts are challenged in the federal courts as being violative of substantive due process, the presumption of reasonableness of such acts will be considered almost, if not quite, irrebutable."

Professor Summers concluded his article in the following vein: "After all, it seems to make little or no practical difference to lease owners whether the Supreme Court has completely abrogated the jurisdiction of the federal courts to review proration orders upon the charge that they violate the Due Process Clause or has retained some scintilla of that jurisdiction to be exercised when the proper situation arises. As long as the Court adheres to the policy announced in the Rowan & Nichols cases there seems to be not the slightest chance of a litigant securing the affirmance of a decree of a lower federal court enjoining a proration order on the ground that it violates the Fourteenth Amendment or the state statute. * * * * * if a trial court should enjoin the enforcement of a proration order as arbitrary, the Supreme Court would no doubt reverse the decision on the ground that the 'Due Process Clause does not require the feel of the expert to be supplanted by an independent view of the judges on the conflicting testimony and prophecies and impressions of expert witnesses' and console the disillusioned litigant by telling that 'The real answer to any claims of inequity or to any need of adjustment to shifting circumstances is the continuing supervisory power of the expert commission.' "

It is difficult, at this time, to estimate the full import of this decision, or to state with any degree of certainty its effect upon oil and gas conservation. It is suggested that the following comments be read as casting further light on this important decision: Johns "Some Aspects of the Effect of the Exercise of Police Power on Correlative Rights in a Common Reservoir," referred to in the first paragraph of this article; Summers "Does the Regulation of Oil Production Require the Denial of Due Process and Equal Protection of the Laws?" 19 Texas Law Review 1 (1941); Davis "Judicial Emasculation of Administrative Action and Oil Proration," 19 Texas Law Review 29 (1941); Summers, "The Rowan & Nichols Case," Supra.

Rapid development of scientific and technical knowledge of oil and gas has caused many unpredictable changes in the legal aspects of problems which confront the producer. Just as the early mistaken idea of the true nature of oil has yielded to the knowledge that, though a prisoner in nature, it is not a vagrant, a wanderer with a fugative existence, the courts will develop more advanced concepts of the legal rights in harmony with these new scientific and technical facts. While the Rowan & Nichols decision has stated it is not for the courts to supplant an administrative tribunal's judgment, it does not follow that oil and gas law must necessarily become the creature of regulatory bodies, beyond the pale of judicial protection. On the contrary, the tremendous importance of property rights involved will bring about a solution to the new problem arising, which will assure the protection of the courts, and the other rule of constitutional interpretation heretofore referred to, the change in economic conditions, will lead to the solution of such problems as time goes on.

Motembo Production Up 56%

Production in the Motembo distillate field in Cuba has increased from 379,840 gal. for the year ended September 30, 1940, to 594,322 gal. for the year ended September 30, 1941.

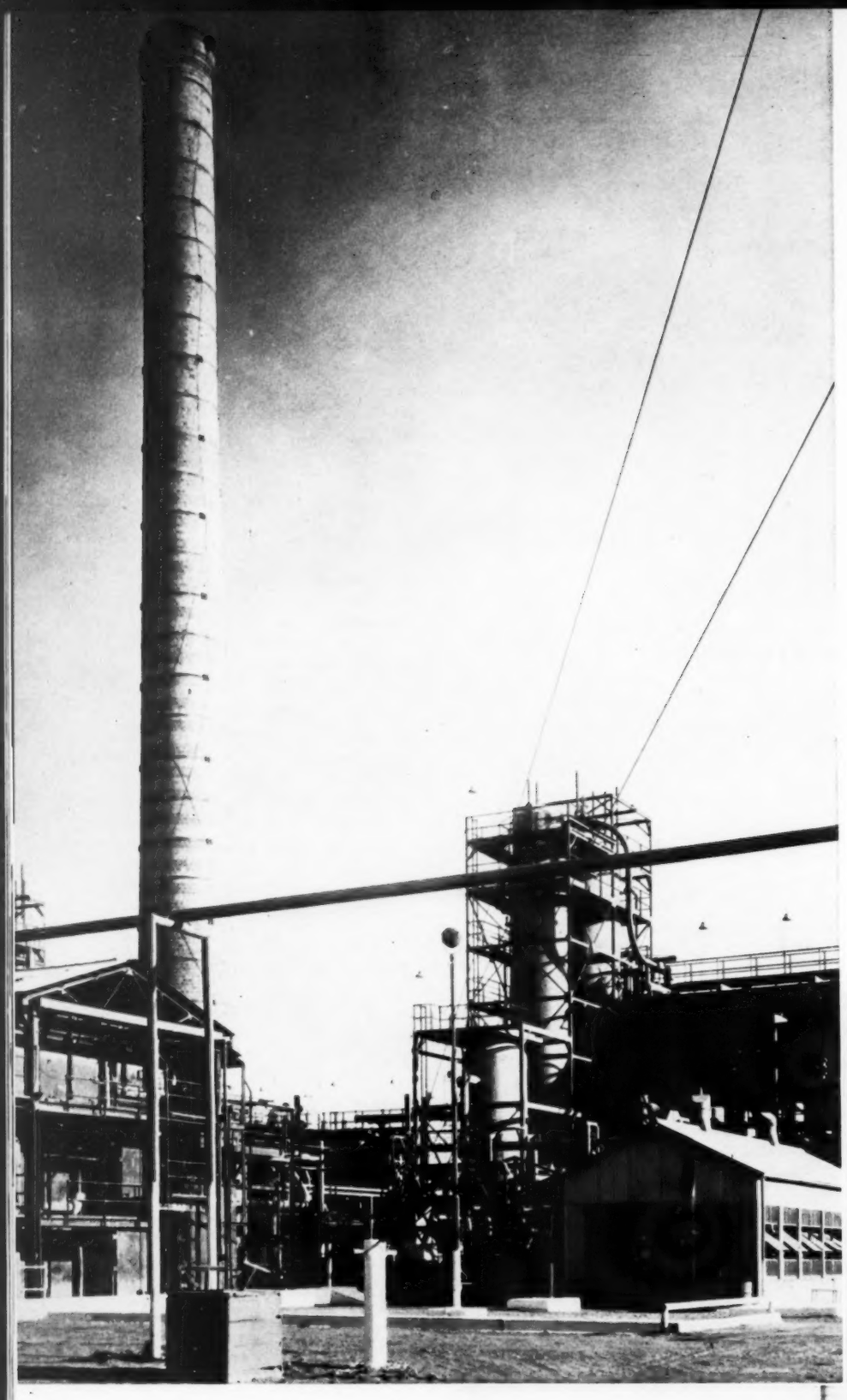
Polyform and G

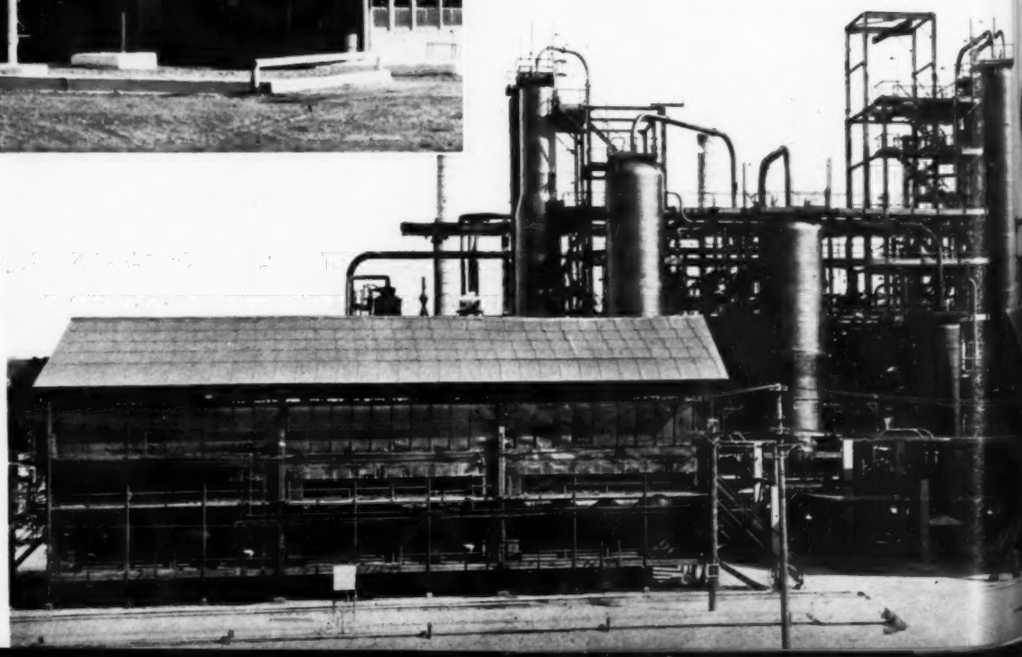
By E. R. Smoley & V. O. Bowles

The Lummus Co.

From a paper presented to the California Natural Gasoline Association, Los Angeles, October 31, 1941.

THE great recent demand by the United States Defense Council and the Army and Navy for large quantities of high-octane gasoline makes this paper especially timely. In this present war emergency, oil-men must carefully consider every method of producing the highest grade of gasoline at the lowest possible cost. Perfection of product is, of course, paramount. But economy in production both as to money and material is vitally important too. The utilization of propanes and butanes from the natural gasoline industry for the economic production of high octane gasoline adheres to this program, as does also the production of butylenes for the manufacture of valuable aviation alkylate. Large government orders and demands for high octane





Above, a naphtha gas reversion unit of the Phillips Petroleum Company at Borger, Texas: Right, a 22,000 bbl. per day combination crude polyform unit.

Gas Reversion in Relation to Natural Gasoline

gasoline have already caused many oil refining companies to investigate and install the new Polyform and Gas Reversion Processes because these processes make both cheaper and better gasoline of higher octane number. Throughout the country polyform and gas reversion plants now process close to 100,000 bbl. per day of naphthas, propanes and butanes, of which approximately one-third are propanes and butanes; a good share of these come from the natural gasoline industry. A year ago there were 11 polyform installations. Today there are 14 such plants in operation and four more under construction. The operation of the last two units recently completed has greatly exceeded expectations in yield, octane and general results.

Because of defense requirements for vast quantities of high octane aviation and motor fuels, and because of the commercial demands for ever higher and higher octane number gasoline, every refiner is vitally interested in elevating the octane of his production by new refining methods. To illustrate these rising trends of motor gasoline octane number, the data submitted by the Bureau of Mines Cooperative Fuel Research Motor Gasoline Survey over the past five years are presented here. Figure 1 shows the trend of the average motor fuel octane numbers in the United States from 1936 to date. The premium grade has risen from 76.8 in 1936 to 80.4 in the winter of 1940-41 indicating a rising trend of one octane number per year. The regular grade has risen from 69.5 ASTM octane to 74.5 during this same period, while the third grade rose from 57.2 to 65.5. Current defense requirements are making it more and more difficult for refiners to maintain the high-octane of their commercial production. This has already been recognized by many refiners who are installing refining processes such as the polyform process which produce a large volume of higher octane number gasoline for blending with refinery production.

Means for many phases of octane number improvement may be provided by the naphtha polyform and gas reversion processes. Straight run heavy naphthas may be polyformed for the production of high yields of 76 to 80 ASTM octane number gasoline. Straight run gas oil, recycle gas oil, or catalytically cracked gas oils may be polyformed to 74-76 ASTM octane number with improved yields over conventional processing, and reduced crude may be polyformed at higher conversions per pass for the production of 70-72 ASTM octane number gasoline. Heavy cracked gasoline may be polyformed satisfactorily to 76 ASTM octane to further improve refinery octane numbers. The use of outside propanes and butanes either from refinery gas or from natural gas in naphtha polyform and gas reversion units has resulted in high yields of high octane number gasoline from this source of raw material. The gasoline produced from polyform units has excellent blending value and good lead susceptibility. The spread between the ASTM and the Research octane number varies from 9 to 14 points and the appreciation of road octane number is excellent. Standard road tests have indicated that naphtha polyform gasoline of the same octane number is equivalent to gasoline made from catalytic processes. Aviation fuels which lead up to 91 ASTM octane number with less than 4 cc. of lead and meeting all Army specifications may be made from the polyform process. This stock may also be used as a base for blending with iso-pentane and aviation alkylate or iso-octane and 3 cc. of lead to produce 100 octane aviation fuel meeting all Army specifications. Polyform distillates are rich in aromatics containing from 3 to 5 percent toluene which may be recovered economically as nitration grade toluol by well known process methods. A very interesting application of the polyform process is the by-product production of a butylene cut which may be used for manufacture of aviation alkylate. Normal butanes from the alkylation plant are returned to the polyform unit to complete the cycle. The use of field butane in a polyform unit for the production of a BB cut for the manufacture of aviation alkylate will add to defense resources by supplying additional blending material for use as aviation fuel. The naphtha polyform and gas reversion processes employ the principle of cracking an oil in admixture with various amounts of normally gaseous hydrocarbons (propanes and butanes). The oil in this mixture can be subjected to higher temperature and higher degree of conversion per pass than possible in the ordinary thermal cracking process without the danger of coke formation in the cracking tubes, and without uneconomically large production of residue gases. Cracking velocities of individual propanes and butanes are increased when admixed with naphtha because of cooperation and partial consumption by alkylation and other synthesis reactions. Thus admixed gases have a pronounced physical effect on naphtha reforming which takes place concurrently with gas polymerization. Conversion conditions in naphtha reforming can be made more severe with attendant greater octane number improvement when the naphtha is admixed with gas conversion stock in sufficient amount. The naphtha polyform and gas reversion processes as applied to the conversion of low-octane heavy naphtha into high-octane gasoline are illustrated in the flow sheet, Figure 2. The naphtha charge is pumped to the top of the absorber tower where it absorbs the propane and butane recycle from the unit. This rich naphtha serves as the furnace charge and after picking up preheat through exchangers passes through the furnace where outlet conditions of approximately 1050 deg. F. and 1200 lbs. pressure are main tained. The furnace outlet is quenched with circulating oil from the bottom of the evaporator tower and discharges into the evaporator and bubble tower which operates at about 400 lbs. pressure and 625 deg. F. flash temperature. The end point gasoline is distilled overhead and stabilized. The stabilizer overhead consists of the propane and butane recycle, and residue gas, which flow through the condenser into the absorber tower where the residue gas is separated from the balance of the recycle. Processing of outside propanes and butanes may be carried out in this unit by adding these materials to the stabilizer overhead or as liquid feed to the furnace charge pump.

The application of the polyform and gas reversion process to the cracking of a full crude is illustrated in the four-coil combination crude polyform unit flow sheet, Figure 3. This flow sheet illustrates a 22,000 bbl. per day crude topping and polyform unit. This one unit replaces the conventional type of crude topping and cracking unit, a thermal polymerization unit and a gas compression and absorption plant. The flow is simple. Crude is charged through heat exchangers and a heater convection bank into an atmospheric crude topping tower from the top of

which straight-run gasoline is removed. Heavy naphtha and furnace oil of kerosene side-streams are withdrawn through stripping towers, and below the furnace oil drawoff a virgin gas oil cut is removed. This virgin gas oil cut is charged hot with propanes and butanes to the virgin gas oil polyform coil where 34-45 per cent gasoline production per pass is obtained. Heavy reduced crude is charged hot from the bottom of the atmospheric tower through the polyform vis-breaker coil together with the heavy tar stripper side-stream and propanes and butanes at a conversion per pass of approximately 14 to 16 per cent. The light recycle stock from the base of the fractionating tower is cracked in the recycle polyform coil with the propanes and butanes to approximately 25 to 32 per cent gasoline per pass. The C_3 and C_4 diluent for these three coils is all furnished as condensate from the stabilizer overhead and is composed of approximately 25 per cent butanes and 75 per cent propanes. Heavy naphtha is passed over the absorber to separate the propane and butane recycle from the residue gas, and the rich naphtha from the base of the absorber is polyformed in the naphtha polyform coil. All four coils discharge into a common separator tower. The 10 deg. to 12 deg. A.P.I. gravity bottoms from this tower are reduced in the atmospheric tar stripper to the desired fuel oil gravity, the overhead from the tar stripper returns to the bubble tower, and the side stream goes to the reduced crude vis-breaker.

Conversion of propanes and butanes concurrently with naphtha in polyform and gas reversion plants is especially interesting to most refiners just now, because the government's vast defense requirements are severely taxing every facility for producing high octane gasoline and are depleting commercial production of high octane components. Resulting increase in tetraethyl lead requirements, therefore, sets a high value on any new high octane production such as may be obtained from propanes and butanes. Table 1 illustrates the profitability of converting propanes and butanes in an average size polyform unit. The values of the propane and butane charges have been varied according to the sources of these materials. Field butane was considered to be available at two cents per gallon. Field propane was considered available at a cost of one cent per gallon. With gasoline bringing six and 6½ cents per gallon at the refinery, an average value of seven cents per gallon for this high-octane gasoline production appears reasonable, the difference representing tetraethyl lead savings. Thus, with present-day plant costs, a payout on the increment investment of 1.7 years for field butane charge, and 3.4 years for field propane charge is indicated. If these propanes and butanes are obtained at fuel gas value, payouts of 1.0 and 3.2 years respectively will be realized; while, if the propanes and butanes are obtained from the plant flare (having no value) then payouts of 0.7 and 1.7 years respectively may be obtained. The processing of propanes and butanes in a polyform or gas reversion plant adds only to the operating expense some utilities and maintenance.

The use of natural gasoline in the direct manufacture of 100 octane aviation gasoline simultaneously with high-octane motor gasoline is an application for the polyform and gas reversion processes which will interest all natural gasoline producers. The hypothetical operation shown in the following example indicates a high potential production of 100 octane aviation gasoline from field casinghead. For example, consider a producer who has available 5000 bbl. per day of 26 lbs. casinghead containing approximately 3000 bbl. of iso-pentane-free natural gasoline, 350 bbl. of iso-pentane, 1100 bbl. of normal butane and 550 bbl. of iso-butane. This stock would be deisopentanized and debutanized and the gasoline separated by distillation into aviation base stock and a heavy naphtha. The heavy naphtha (1500 bbl.) would be polyformed with 1100 bbl. of normal butane for the production of 1300 bbl. per day of 76 octane motor gasoline and at the same time a by-product butane-butylene stream

TABLE 1

Butane and Propane Conversion in a Naphtha Polyform or Gas Reversion Unit

Charge Source	Case I-A Butane Natural Gas	Case I-B Butane Fuel Gas	Case I-C Butane Plant Flare	Case II-A Propane Natural Gas	Case II-B Propane Fuel Gas	Case II-C Propane Plant Flare
Quantity, Bbls./Optg. Day	1,000	1,000	1,000	1,000	1,000	1,000
Yields:						
Gasoline, Bbls./Optg. Day	460	460	460	350	350	350
Fuel Oil, Bbls./Optg. Day	35	35	35	25	25	25
Fuel Gas, Bbls./Optg. Day (F.O.E.)	280	280	280	305	305	305
Charge Value,* $/Day	840	440	—	420	395	—
Operating Costs,** $/Day	135	135	40	275	275	75
Management, Interest, Taxes, $/Day	75	75	75	140	140	140
Total Charges, $/Day	1,050	650	115	835	810	215
Gasoline Value @ 7.0c gal., $/Day	1,350	1,350	1,350	1,060	1,060	1,060
Fuel Oil Value @ $0.70/Bbl., $/Day	24	24	—	—	—	—
Fuel Gas Value @ 10c/MM Btu, $/Day	175	175	24	17	17	17
Total Receipts	1,549	1,549	1,374	1,268	1,268	1,077
Net Return, $/Day	499	899	1,259	433	458	862
Net Return, $/Year	165,000	297,000	415,000	143,000	151,000	285,000
Increment Plant Cost, $	285,000	285,000	285,000	485,000	485,000	485,000
PAYOUT TIME, YEARS	1.7	1.0	0.7	3.4	3.2	1.7

*Natural Butane @ 2.0c/gal., Natural Propane @ 1.0c/gal., Fuel Gas @ 10c/MM Btu.

**Utilities: Fuel @ 10c/MM Btu, Water @ 0.5c/1000 gal., Power @ 0.5c/KWH, no plant steam required.

TABLE 3

Pilot Plant Data Polyforming California Naphtha

Run No.	1	2	3	4
Operating Data				
Coil Outlet Temp. °F.	1070	1080	1090	1100
Coil Outlet Press., Lbs./Sq. In.	1500	1500	1500	1500
Tower Press., Lbs.°Sq. In.	300	300	300	300
Yields, Vol. %				
Stabilized Dist.	92.4	90.3	83.9	79.7
Tar	1.3	1.6	3.8	4.8
Gas F.O.E.	6.2	7.3	12.2	15.2
Laboratory Inspections				

	Charge Naphtha	Stab. Gasoline	Tar	Stab. Gasoline	Tar	Stab. Gasoline	Tar	Stab. Gasoline	Tar
A.P.I. Gravity	52.9	55.1	16.3	54.2	10.0	53.5	8.2	53.6	8.3
R.V.P. Lbs./Sq. In.	—	8.8		8.5		9.5		9.1	
A.S.T.M. Distn. °F.									
I.B.P.	160	93	394	95	426	94	421	92	428
10%	211	153	485	155	500	144	491	139	480
50%	267	247	526	245	599	238	591	234	571
90%	344	348		360		349		359	
End Point	397	404		420		413		408	
A.S.T.M. Octane No.	58.3	73.8		75.5		78.2		79.3	
Research Octane No.	—	83.7		86.3		89.4		—	

Commercial Polyform Operation of Texas Naphtha With Outside Propanes and Butanes

Research Octane No.	87.5	81.0
Operating Data		
Coil Outlet Pressure, Lbs./Sq. In.	1200	1200
Coil Outlet Temp., °F.	1062	1040
Evaporator Bottom Temp. °F.	625	625
Evaporator Press., Lbs./Sq. In.	390	390
Absorber Pressure, Lbs./Sq. In.	340	340
Yields, Volume %		
Charge Naphtha	100.0	100.0
Butanes	20.7	20.3
Propanes	16.6	15.4
Stabilized Gasoline	98.0	110.0
Fuel Oil	4.8	2.4
Calculated Vol. % Stab. Gasoline on Naphtha Alone	83.5	95.5
Laboratory Inspections		
R.V.P., Lbs./Sq.In.	9.7	10.0
Visc. SUS @ 122°	19	15
B.S. & W., %	0.4	0.4

A.S.T.M. Distn., °F

	Charge Naphtha	Stab. Gasoline	Tar	Stab. Gasoline	Tar
A.P.I. Gravity	51.2	57.2	9.5	59.2	12.0
I.B.P.	205	95		94	
10%	260	130		134	
50%	310	232		243	
90%	360	339		327	
End Point	400	389		385	
Research Octane No.	44.0	87.5		81.0	

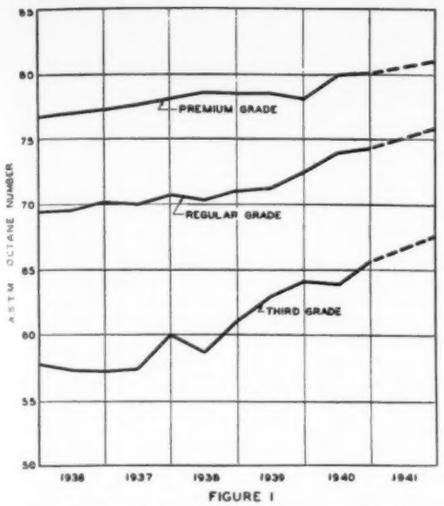


FIGURE 1

Fig. 1: trend of average octane number in U. S.

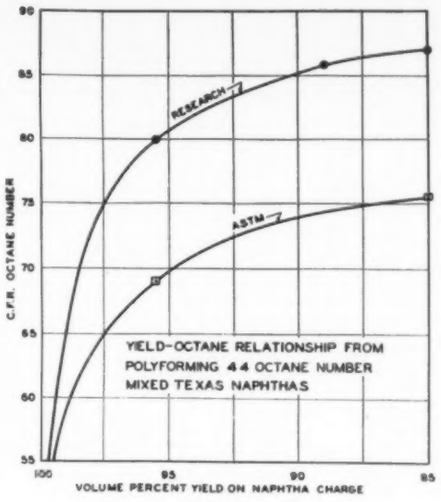


Figure 4.

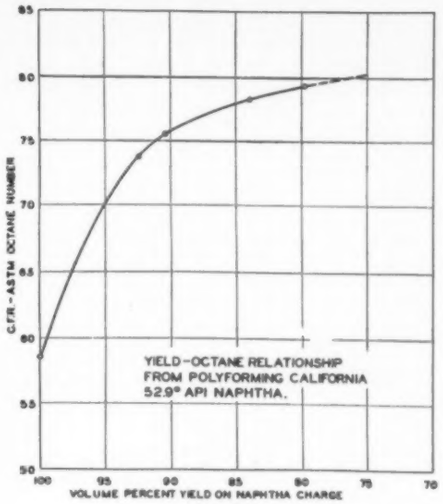


Figure 5.

would be withdrawn and charged to an alkylation plant along with the 550 bbl. of iso-butane with a production of approximately 1000 bbl. per day of 93-95 octane aviation alkylate. The normal butane from the alkylation operation would all be recycled to the polyform plant. The alkylate would be blended with the 350 bbl. of isopentane and 500 bbl. of the aviation base stock produced from the original natural gasoline, resulting in a net production of 1850 bbl. per day of leaded 100 octane gasoline. Thus a charge of 5000 bbl. per day of 26 lbs. casinghead of the characteristics noted could produce 1850 bbl. per day of 100 octane aviation gasoline plus 2300 bbl. per day of 73 ASTEM octane motor gasoline. This example indicates a high volumetric yield of 100 octane aviation and high-octane motor gasoline from the original natural gasoline charge comparing favorably with other uses.

Operating data from commercial polyform and gas reversion units have been published in the oil journals September 1940 and the American Petroleum Institute Proceedings, November 1940. Yields, octanes, lead susceptibility, inspections of charge and products, operating conditions, and blending results are given for various types of charge stocks and operations. A large polyform unit charging straight run naphtha of 250-400 deg. F. boiling range and about 45 octane number from a mixture of Texas and Coastal crudes along with outside propanes and butanes has recently been completed and placed on initial operation. During two four day test runs with frequent gaugings, accurate yields of 83.5 per cent of 10 R.V.P. 400 end point gasoline with a Research octane number of 87.5, and 95.5 per cent of 10 R.V.P. 400 end point gasoline of 81.0 Research octane number were established. Table 2 presents some of the operating data. This yield - octane relationship as shown in Figure 4 for both the Research and ASTM octane numbers is well substantiated by more than 750,000 bbl. of gasoline production in this plant at varying octanes. A series of runs were made in the pilot plant, processing 52.9 API gravity California naphtha with a boiling range of 160-400 deg. F. end point, having 58.3 ASTM octane number. The runs were made at a coil outlet pressure of 1500 lbs. and temperatures ranging from 1060 deg. F. to 1100 deg. F. The operating conditions, yields, octanes, inspections of charge and products are given for the four runs in Table 3. Figure 5 shows the yield-octane relationship, indicating an 80 per cent yield of 79 ASTM octane number gasoline and a 90 per cent yield of 76 ASTM octane number gasoline. As would be expected from this California naphtha charge stock, a considerably higher yield-octane relationship was obtained than from Mid-Continent or Texas naphthas. These results indicate at least a five per cent higher yield at this octane range than would be possible from Texas or Mid-Continent stock.

Because of the naturally high octane number characteristic of most California straight-run gasolines, and because of the generally higher octane of cracked gasoline produced from the heavier oils, reforming California straight-run naphthas has not been practiced widely until very recently. However, the effect of defense requirements on the quality of commercial gasoline production, as well as the ever rising octane level of all grades of gasoline will make it exceedingly difficult for most refiners to maintain the present high octane level of their commercial production, even with all existing cracking facilities being employed to the fullest extent. For this reason the processing of low-octane gasoline components in polyform and gas reversion units is rapidly becoming a necessity. The production of high octane gasoline from propanes and butanes not now being diverted to gasoline production is especially profitable where it can be carried out concurrently with naphtha polyforming, and is a step toward more efficient utilization of the nation's natural resources. This is particularly desirable during the defense emergency. The by-product manufacture of butylene for the production of valuable aviation alkylate is, furthermore, becoming imperative. Refiners are recognizing these factors everywhere and the polyform and gas reversion processes should find even greater application in the refining industry in the future stimulated by extraordinary demands arising from the national defense program.

Fig. 2: naphtha polyform plant.

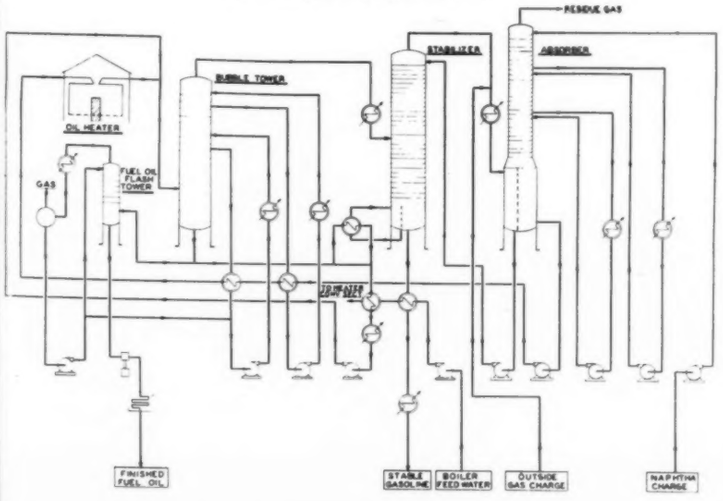
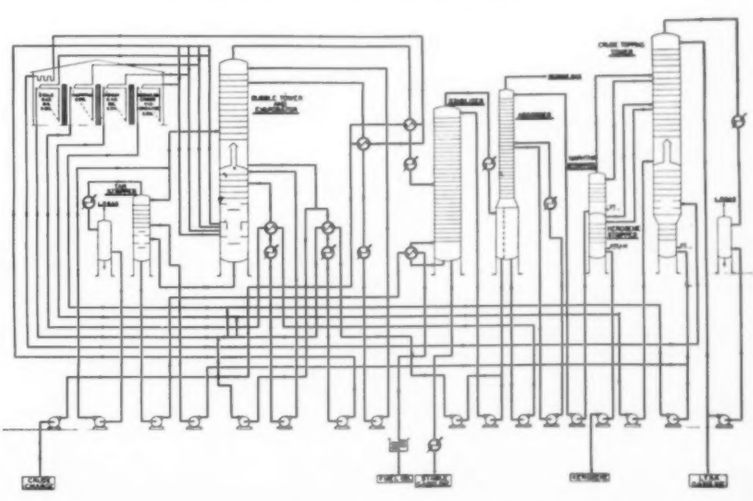
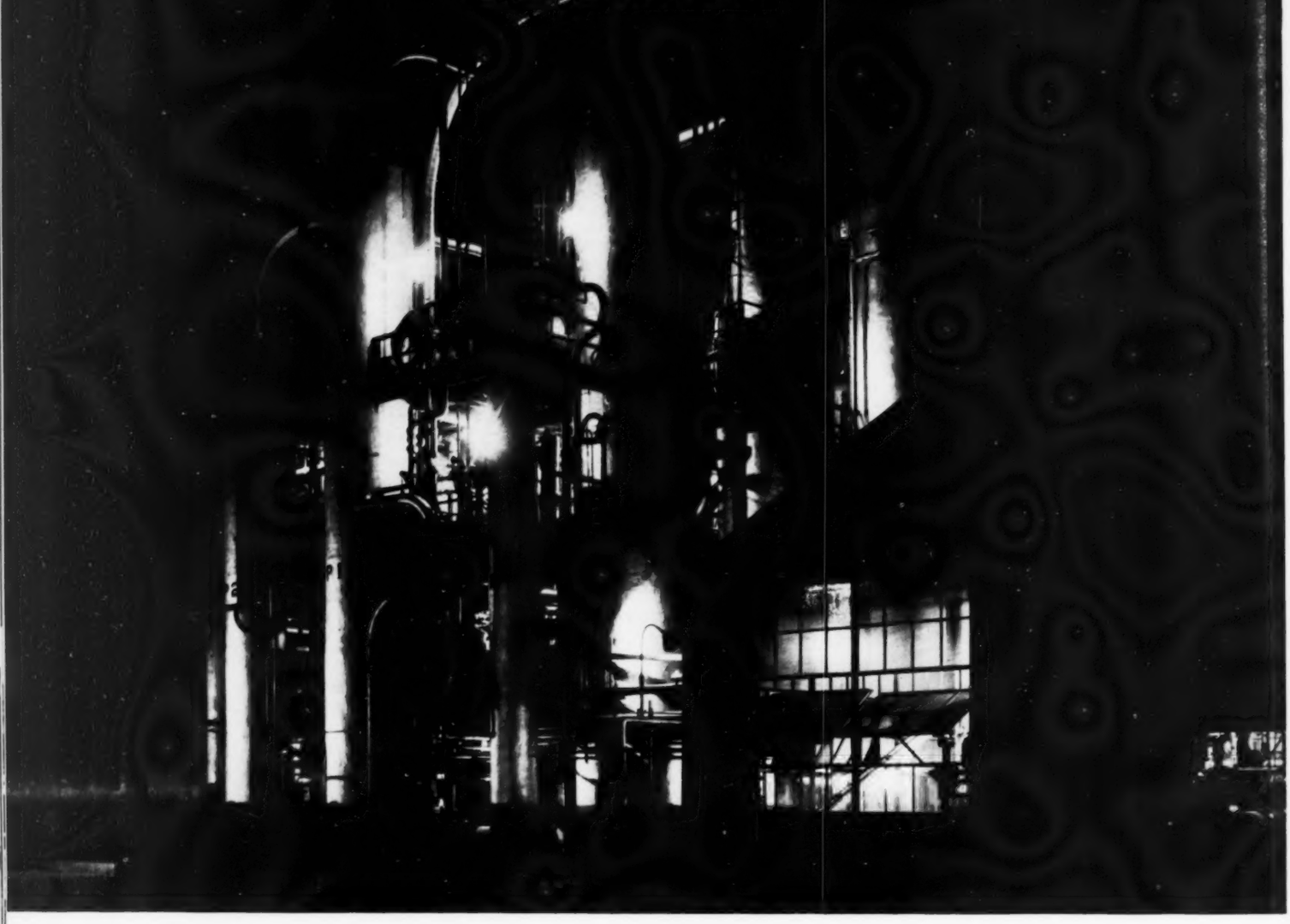


Fig. 3: four-coil combination crude polyform unit.



WHAT SHALL BE DONE ABOUT PRORATION

By Dr. O. W. Willcox



Third and Last of a Series of Articles Outlining the Application of Sugar Proration to the Oil Industry. The First of These Articles Appeared in the May, 1941 Issue; The Second in August.

THIS SERIES of articles has been written in the belief that a great majority in the petroleum industry of the United States is interested in and approves of proration as an instrument capable of promoting the best interest of the industry as a whole, and that most of the industry would very much like to see the present partly developed system brought somewhat closer to perfection. But perfection is a matter of opinion. The most that can be recommended is to examine existing systems and measure their approach to perfection by the degree of their practical success. The prorating system that has been highly developed in the world-wide sugar industry has had enough practical success to warrant close examination of it by other industries that have been experimenting with the proration principle.

In examining proration as it is practiced in the more advanced sections of the sugar industry the oil men will naturally focus their attention on those features which are novel in the sense that no attempt has so far been made to incorporate them in the system now more or less in effect in the American petroleum industry. To recall what has been said before, these features include: The system is made nation-wide and takes in (as charter members) every visible primary producer and every visible processor. Both wings of the industry are separately organized and join in creating a central association which negotiates with the public authorities on behalf of the industry, distributes the business proratably among the primary producers and the processors, keeps out unneeded newcomers, takes charge of the product from the points of origin of the raw material to the ultimate distribution points of the finished goods, and collects a legally fixed price from the consumers which is prorated back to the producers on a legally determined basis that will ensure the economic survival of all elements of the industry. It is to be remembered that the terms of the industry's charter were first democratically thrashed out in a plenary confer-

ence of the whole industry and were presented to the government as the considered opinion of what the industry needed, wanted, and was prepared to do. The government, "finding that the agreement inflicted no injury on particular interests, took care of cases of special hardships, and was not otherwise contrary to the public interest" (we quote these phases from the South African sugar legislation), approved it and got parliamentary approval for it. Thereupon the industry democratically elected its executive committees and boards, and proceeded to run its affairs under a charter virtually written by itself.

It is next in order to consider what the American petroleum industry might accomplish under such a charter. Since we are necessarily speaking "before the fact," what follows is more or less conjectual. One of the first results would most likely be an immediate and final disposition of some vexatious and controversial matters that are now raging within the industry, and between the industry and highly placed individuals in the federal government in Washington.

Take, for instance, the proposed divorcement of pipelines. Most or many of these arteries of transport were built at large cost by the majors who are both operators of oil wells and operators of refineries. Besides transporting their own crude oil they accept for transport crude oil produced by operators who control no pipelines, and deliver shipments of crude oil to independents who also control no pipelines. Some of the majors also have their own pipelines for transporting their finished products (gasoline) to market. Whether with or without justification the minors and the independents have complained that this situation is on occasion discriminatory, unfair, and more or less oppressive on them, because the majors are alleged to obtain certain economic advantages which give them a superior competitive position in the market for petroleum products. Without going into the details or the equities involved, it can be taken for granted that a Central Sales Agency for the petroleum industry would make short work of the whole matter. All oil well operators, whether biggest major or smallest minor, would stand on exactly the same footing. Neither would have any right or privilege other than to receive a duly proclaimed stable base price f.o.b. lease for their quota of crude oil that meets pipeline specifications, regardless of geographical location. Thereafter they would not have the smallest concern with it; it is now the property of the industry as a whole. The pipeline company would receive a duly ascertained payment for its services on a bbl.-mile basis, and any dividends that might accrue to a major company owning stock in the pipeline company could not have the smallest effect on the economic positions of the minors. The same applies to the refining stage. All refineries, regardless of ownership or location, also would stand on the same economic footing; they would all have the same status of local converters or processors for toll, paid at a rate and on a quota that will sustain them as going industrial concerns. Whether a refinery has a pipeline to carry its gasoline cheaply to market, or must ship expensively by tank cars, makes not the smallest difference to either the big or the little refinery. The Agency, which takes and pays for the quota of every refinery, assumes all that.

Another serious disturbance in the petroleum industry that could not arise under a completely thought-out system of proration is the perennial conflict between the industry and the trust-busters; the so-called Madison case is an instance. This conflict is traceable to the imperfect recognition of the radical difference existing between the social-economics of an unsaturated industry and the social-economics of an oversaturated industry; in a preceding section of this discourse it was pointed out that a public policy appropriate to the first condition cannot be applied in the second condition without damage to the public interest; and that promotion of destructive competition in order that the ultimate consumer may buy in the cheapest of all possible markets is in the end injurious to the consumer himself, in proportion as it impairs the purchasing and wage-paying ability of the industry as a whole. A modern system of industrial proration, by its very nature, implies a recognition of the social-economic dangers inherent in a condition of industrial oversaturation. In ratifying an agreement to install such a system the public authorities subscribe to the modern doctrine that instead of giving precedence to the desires of the ultimate consumer it is the essential interests of the producers that demand first consideration, because production must obviously come before consumption and the producer before the consumer. It is the essence of a modern system of industrial proration that destructive competition must be done away; and the most completely successful instrument for suppressing destructive competition yet invented is the Central Sales Agency, of which the world sugar industry now has numerous shining examples.

When and if the petroleum industry of the United States acquires such a central sales agency there will be no recurrence of a Madison case, which arose out of an attempt to neutralize the disastrous consequences of an oversupply of distress gasoline. There will be no oversupply nor distress. The Central Sales Agency, being in sole possession of the entire supply, delivers it to the consumers in the full measure of their demand; any temporary surplus is merely stored to await its turn to go to market. In the meantime the surplus, although a plainly visible stock, has no market influence because the agency will not offer it for less than the legally fixed price, and the Quota Committee will see to it that production is brought back into line with consumption, plus a prudent reserve stock.

Another clouded situation in the American petroleum industry into which a modern system of proration will introduce clarity is the matter of conservation. As was outlined in the first section of this article there is a state of polemical warfare between the industry and highly placed individuals in the government over two principal points. One of these points is that the industry (meaning especially the stronger interests) is not treating all its own elements fairly. The big fellows are said to be bulldozing and oppressing the little fellows. Without saying yes or no on that point, we have already shown that all possible bases for such an accusation are removed in a modern system of industrial proration, wherein the big fellows voluntarily make concessions and accord astonishing preferences to the little fellows to an extent that enables every last one of them to keep economically afloat. Surely the government could want no better treatment for the economically weak, whom it laudably desires to save from extinction.

The other principal source of hostilities between the industry and government officials includes the matter of conservation. The industry is accused of wasteful practices that tend to dissipate a precious national resource, hastening the time when the irreplacable and by no means unlimited reserves of petroleum will have become exhausted. On whether there is waste in the petroleum industry we again say neither yes or no. It will be sufficient for present purposes to consider how the conservation problem will undoubtedly be handled under a modern system of industrial proration. The task will fall on the Quota Committee, which has the job of furnish-

The petroleum industry, like sugar, falls into four main classifications: production, refining, transportation and marketing.

ing the Central Sales Agency with all the raw material needed to supply the demand, and of giving each primary producer his share of the business. The first act of the Quota Committee will be to prohibit production from newly drilled wells so long as the required supply can be obtained from existing wells, when the existing wells are normally and "optimally" operated. Optimal operation of an oil well is defined by well-informed petroleum technologists as the withdrawal of oil at a rate that will make the completest possible use of the formation pressure and assure the fullest possible ultimate recovery; the most ardent conservationist could not ask more. Quotas will be computed on that basis. What shall be the optimum producing rate for a given well will be determined by the Quota Committee's own engineers (paid out of the Central Sales Agency's general expense fund), no doubt assisted by engineers of the Bureau of Mines, as referees. Aside from the Bureau's engineers and revenue officials who check the accounts of the Central Sales Agency and collect the gasoline and other taxes, no other government officials need appear in the proration picture, all other administrative matters being covered in the agreement between the government and the industry, that has been enacted into law.

The matter will not be a simple one at first. Because of the great number of existing wells that will be taken into the system at the start, and which have allowables far below their known potentials, it will be impossible to operate all of them at the optimal rate (Secretary Ickes himself could not do it without completely drowning the market with surplus oil). But as the number of existing wells that approach exhaustion increases, the Quota Committee (still barring new production) will correspondingly enlarge the quotas of those that are still held down by their allowables. Only when all existing wells are operating at their optimal rates, and collectively have begun to show signs of failure to keep pace with needs, will new wells be taken into the system; and these will be optimally operated from the start. No basis is thus left for complaints of wastage or violation of true conservation.

The proposition that the Quota Committee shall bar new production so long as the existing wells under optimal operation are able to supply the needs will seem to raise a formidable problem, but it is really very simple. It is quite true that there is now a none-too-comfortable margin between annual withdrawals and proven reserves, and that to preserve this margin (not to speak of enlarging it) it is imperative to keep up an active drilling program and to have new oil pools ready to take the place of those that become exhausted. But will not wildcatters of every description be more loath to risk their good money in drilling for new pools—a hazardous financial game at best—if they have to wait an indefinite period before they can begin to recoup the heavy outlay they put into a well that has struck oil? Undoubtedly, this prospect would be something of an added deterrent. But the Central Sales Agency will eventually, and certainly, need that oil, and it will be easy to insert into the agreement a clause or two that will enable the Agency to calm such fears. The Agency controls a central fund which the public creates when it pays the fixed price, and into that price is written every legitimate item of expense, immediate or contingent, that enters into the production of the commodity. One item legitimately included is insurance, and due to the peculiar nature of the petroleum business it is vital to insure a continuing supply. Hence the Agency may be permitted to allocate a portion of its fund for immediate advances (perhaps in the form of interest bearing bonds) to adventurous wildcatters who have found and proven new pools which must be kept shut in until it is their turn for optimal operation. The public need not grumble at this extra surcharge on the price. It wants a continuing supply of petroleum and it wants its oilfields optimally operated and conserved so as to prolong their useful line as long as possible. Oilfields and the petroleum industry being what they are, no one should get the idea that conservation will cost nothing, or forget that rational conservation will be worth more than its cost. It is, therefore, necessary to provide a substantial inducement for continued exploration.

While sugar is not yet transported by pipeline like oil, this jungle flume resembles one aspect of oil transport.

Closely interlocked with the broad conservation problem is the vexatious matter of unit operation. In fact, it is difficult to see how the oil in a pool can be properly conserved and its wells optimally operated unless the pool is managed as a unit. The proposition presents no difficulty at all when the oil field is under the control of a single lessor-operator, but it seems that in most fields diverse ownership is the rule. Where there is diverse ownership the old law of capture is pretty sure to raise its ugly head; competitive drilling and production play hob with conservation. The conservationists will therefore need an effective weapon against multiple owners of oil rights, and must find a way to overturn the ancient doctrine that perpetuates the law of capture. With a little carefully thought-out management (and perhaps a little cooperation from the courts, which it seems is not too hard to get these days) the Quota Committee and the Central Sales Agency appear to be instruments well suited to the purpose. For one thing, federal legislative sponsorship of proration and a nationwide system of marketing quotas has already won a firm footing in court decisions, and the doctrine that the legislative authority may specify the terms under which any commodity may enter the stream of interstate commerce appears to

be solidly established. In fact, the matter has been placed beyond the shadow of a doubt. In a series of decisions (prominent among which is the Tobacco Warehouse case) the Supreme Court has declared that the power of Congress over interstate commerce is absolute; it may even prohibit any interstate commerce at all. Much more, then, says the Court, may Congress impose terms on such permission as it may grant for the movement of an interstate commodity, which petroleum and its products certainly are. On this background the legal experts who assist in drawing up the proration agreement may be able to frame measures that will allow the Quota Committee to withhold quotas from oil properties until the Quota Committee's engineers certify that the oil will be produced without damaging legitimate, private or public interests; and to prohibit the Central Sales Agency from accepting, for transport, refining and sale in interstate commerce, the oil of any producer who does not have a quota. This double-barreled control would seem amply sufficient to force unit operation on the most recalcitrant hold-out, who of course would be allowed recourse against arbitrariness. We turn next to another aspect of proration systems which is among the most striking but perhaps the least generally known of the social-economic novelties that have had their origin in the world sugar industry. This aspect of proration was foreshadowed in the first section of this article, where it was set forth that an industrial monopoly may be made to serve vital public purposes, and that combinations which suppress free competition and control prices may be indispensable features of a very sound national housekeeping. As a preliminary to this new turn of the discussion it will be recalled that under a logically developed system of proration for a saturated industry the financial status of the producer is settled once for all on the basis of a price that will sustain his enterprise and his workers. To state the matter baldly and broadly, he is, in effect, paid an agreed wage for performing a fixed task in the service of the community, and the fixed price which the public is called on to pay him for the product shall at the least be high enough to cover that agreed wage. Beyond that little matter of "at the least" is a field of indefinite extent. The public authority, which has the last say on what the fixed price shall be, will certainly not limit the price to just enough to sustain the industry. The public treasury has to be fed, too, so the base price, which is the irreducible minimum that goes to the producer, is surcharged with whatever taxes seem advisable. This tax surcharge may on occasion be increased, but none of the increase is absorbed by the producer; on occasion the tax surcharge may even be reduced, but the lightened tax is for the benefit of the public and again does not affect the producer's income, which on the same volume of business remains constant. Of such is the ultimate nature of a fully developed system of proration in a saturated industry. The reader will easily get the idea: beyond what is necessary to sustain the prorated industry as a whole, the public authority will (and does) tack on the basic fixed price as many surcharges for as many different purposes as the public interest seems to require. There is, of course, a limit, which is the point where the tax load begins to decrease consumption and to lower gross income from sales of the product. But up to what the learned economists call the "point of maximum vendibility" the controlled price of a prorated commodity may prove a rich and very easy source from which to nourish a variety of social-economic projects. It has been so in the world sugar industry, but in the limited space available it is not possible to show even a small part of what has been accomplished on that principle. We will mention only two examples taken from the sugar industry to illustrate how it works.

Under the proration plan outlined in the accompanying article, transportation would be handled by the Central Committee and production or refining returns would not be affected by distance from markets.

In several countries the business of manufacturing fruit products for export was languishing for lack of sugar at a sufficiently low price. In consultation with the government, the industry agreed to put out a suitable canning and preserving grade at a price that was somewhat be-

With transportation for the whole industry handled as a unit under the proration plan proposed herewith, large economies would be possible.

low cost. To hold on to the principle that the sugar producers shall not suffer from any price change, the fixed price of fine granulated sugar was surcharged enough to recoup what was granted to the fruit men. Result: a powerful impetus to fruit growing; orchards appeared on hills theretofore considered worthless for any agricultural purpose. More farmers and laborers obtained work, more foreign exchange flowed into the country, the national wealth was not negligibly increased, and consumers of the fancy article hardly notice the difference.

In other countries where the sugar industries were fully prorated there were large sections of the population that had a low per capita sugar consumption, due to low purchasing power. By agreement between the industry and the government a grade acceptable to the submerged classes but not quite fine enough for the fastidious middle and upper classes was put out at a sufficiently low price; to cover the difference and maintain the sugar industry *in status quo* the price of the fancy article was suitably surcharged without appreciably lessening demand for it. Results: a decided increase in sugar consumption among the underprivileged, which actually increased the total national consumption and gave more work for farmers in addition to health benefits.

If the petroleum industry of the United States ever gets a fully developed system of proration it is most likely that its price policy will take a more or less parallel social-economic slant. The industry will be given a base price to sustain it; that is elemental, because the producer must be taken care of ahead of any other interest. But beyond that, its income-producing potentialities will be definitely in the public domain. The vast variety of petroleum products and the almost infinite variety of uses to which they may be put, together with the great extendibility of the price of its most desired products, will offer a tempting field for social-economic exploitation. Among the many possibilities which suggest themselves we will again select two for illustrative purposes.

The United States produces none, or only an infinitesimal amount of the vast quantity of natural rubber it consumes. This is a weak spot in the national economy which on occasion could give rise to serious difficulties of which most of us at the moment are acutely aware. Very satisfactory artificial rubbers may be synthesized in huge quantities from petroleum products, for instance butadiene, but the cost of such artificial rubbers is relatively greater than that of natural rubber. Hence the artificial rubber industry is languishing for lack of a sufficiently low-priced raw material. The government goes into consultation with the Central Board of the fully prorated petroleum industry and an agreement is reached whereby the industry will furnish butadiene at the necessary low price, and recoup what it may lose in the process by a surcharge on the prices of its other products that are being marketed below the point of maximum vendibility. Probable result: the creation of a new national industry that provides more employment, enlarges the national wealth, readjusts the balance of foreign trade, and obviously contributes to the national security. The users of other petroleum products may or may not grumble, depending on whether the surcharged prices appreciably pinch them; but it should be possible to console them by calling their attention to the new national wealth that has been created by their sacrifices, and some of which will surely backwash even unto them like bread that is cast upon the waters. In putting before the reader our second hypothetical example to illustrate how a fully prorated petroleum industry (wherein both the product and its price are under absolute control by the democratically chosen representatives of the industry working in close collaboration with the public authority) may serve weighty purposes of a sound national housekeeping, we will begin by recalling something that we have already said.

Most oil men (like practically all sugar men) are heartily in favor of proration because it appeals to them not only as a way out of an insupportable economic situation, but also because it conforms to the elements of fair play and the principle of live and let live. All the producers are given a relative status that is readily accepted as equitable. Every man is confirmed in the relative position he has already won as an established producer. No competitor, either domestic or foreign, can dislodge him from that position. He and his colleagues, each of whom occupies a similar position, are mutually and effectively bound to respect each other's positions. That is, no one of them will or can throw on the market an amount of product in excess of ihs share, and offer it at a lower price in the hope of pillaging the business of his neighbor. In the midst of this critical era through which we of this generation are now passing the writer deems it highly apropos to use a little of his precious space to point out that here is a momentous new development in substantative law. Since the most ancient times the right of a man to the peaceable and exclusive possession of his property has been respected and defended. Every man is confirmed in the ownership of the house that shelters his family, the farm which he tills, the tools and the shop in which he plies his trade, the mine from which he digs minerals; such property rights are essential to his existence. But, for all that, he is still left in economic insecurity. Of what real use is a farm, or a shop, or a mine, or an oil well, or an oil refinery, or a sugar factory, if the output of these means of production cannot be sold for enough to cover the necessities of the producers? By the very nature of things, a man must effectively market his product as well as effectively produce it to obtain a living.

Now, it is the especial characteristic of a saturated industry that very great difficulties arise to hinder or prevent effective marketing; the too-numerous and too-effective producers are impelled to efforts to grab for themeslves as large a share of the limited volume of business as they possibly can, and each generally ends by damaging himself as well as his rivals and even the public. It is out of such circumstances that a new and enlarged conception of property rights has arisen and has become firmly established in all fully prorated and controlled saturated industries. The right and title of ownership of the means of production now carry with them the indefeasible right and title to a corresponding place in the market, which on final analysis may be condensed in a phrase that we have already used: No man in a saturated industry shall be allowed to pillage his neighbor's living.

After this somewhat lengthy but necessary prologue we may return to the matter in hand, which is to give a second hypothetical example of how a fully prorated and controlled petroleum industry may serve weighty purposes of sound national housekeeping. But it is first necessary to recall another underlying fact. Competition for the same market is not always confined to producers in a given industry. The products of two very dissimilar industries may compete for the patronage of the same consumers. In the free play of uncontrolled economic forces there can arise between these two industries the same condition that arises within a single industry: the strong overpower the handicapped and the weak. The less effective or less favored of the two competing industries loses ground; its capitalists are beaten; its laborers lose employment and their purchaisng power; the thriving communities which the beaten producers formerly supported fall into decay, and in the end the industry may disappear entirely as a tax payer and work-giver, leaving an unwelcome public heritage of stranded communities and incurable poverty.

The fact is that certain petroleum products compete with the coal industry. As between oil and coal as industrial fuels the advantage is in favor of oil. As a result, more and more oil burning equipment is being installed, and more and more coal miners are losing their jobs. The inroads which the oil business has made and is still making on the coal business have created a bad social-economic situation, which some prominent oil men have publicly deprecated while confessing inability to think of a way out, and it is known to be on the list of things which high New Deal officials expect to get around to when they can. In any event, it presents a problem.

When and if the petroleum industry of the United States acquires an up-to-date proration system a benign government that wants to do something for the distressed coal industry will no doubt find in this system an ideal instrument for the purpose, and in proceeding to use it the government will undoubtedly have the hearty cooperation of the oil men. Why not? If the petroleum industry ever gets the complete system which we have outlined at some length, it will do so only because a great majority of its members have desired it, and have decided to accept both the benefits and the obligations of the system. One of the obligations is that no man shall pillage the livings of his colleagues in the industry, and it would be strange indeed if oil men should balk at a reasonable extension of the obligation to fellow citizens who are not oil men, especially if it requires no sacrifice of what they already hold. The matter will presumably be arranged thus: The Central Board of the petroleum industry and the public authority will go into conferences (such conferences are provided for in the agreements and are subject to certain rules). The conferees will hardly attempt to repair the damage already done. Congress will certainly not be asked to pass a law requiring owners to scrap their oil-burning equipment and go back to coal, nor to prohibit new installations. The use of fuel oil will be as free as ever, but with one modification. This modification arises from the new principle which has become public policy as applied to fully prorated sugar industries. It is the principle that consumers shall pay the full cost for what they consume. Full cost means not only the full technological cost, but also the full social-economic cost. A little reflection will show that while the possessor of a domestic oil-heating plant which requires practically no attention, gives an even heat, requires no stoking and does away with the ash nuisance, may be paying the full technological cost of his oil, he is contributing nothing to the social-economic cost. In the very act of obtaining his own comfort and convenience he is taking something from the comfort and the means of existence of coal miners, with corresponding damage to the public interest.

Now, when the Central Board of the petroleum industry and the public authority sit in conference over this matter, in all likelihood they will rise with an arrangement something like this: the price of fuel oil will be surcharged enough to make good the damage currently inflicted on the livings of coal miners. The purpose will not be to halt the drift to oil. All consumers of fuel oil can still get all the fuel oil they are willing to pay for, but they will now pay enough to create a fund which the Central Sales Agency is instructed to pay to an agency that might be named an Authority for the Salvage of Displaced Coal Miners, whose business it will be to help miners thrown out of work by growing use of fuel to a new way of living. There are of course, certain complexities of the matter which we will not take space to unravel, but all these blend together to give effect to the purpose which is the ultimate object of all proration systems in saturated industries. No man, and no industry, shall pillage the living of another.

When oil men have finished reading these articles and begin to examine for themselves the workings of proration in the world sugar industry, they should be warned not to expect to find everything we have described in the sugar industry of the United States. The American sugar industry indeed has a system of proration that is advanced far beyond proration in the petroleum industry, but it is still under the thumb of bureaucracy, and is suffering generally from the same failure to appreciate the difference between saturated and unsaturated industries that cripples much social-economic action in the United States. It will be much more enlightening to examine the systems that have been developed in democracies like Australia, Sweden, South Africa, France, Czechoslovakia, Poland (before Hitler) and Germany (also before Hitler); Latin American democracies like Argentina and Brazil; Yugoslavia and Roumania; and even such autocracies as Italy, where the sugar industry has a self-written and executed charter and an organization that may well be described as marvelous. Fuller details may be found in one of the writer's books.[1]

[1] Can Industry Govern Itself? by O. W. Willcox, World Petroleum Book Department. $2.75.

The sugar industry outside the United States has found complete "proration" an effective means of controlling a saturated industry.

Foreign Oil Legion

James Tanham, left, recently elected vice-president of The Texas Corporation and The Texas Company. Mr. Tanham has been with Texas since 1919. Torrey H. Webb, right, vice-president and general manager of The Texas Company (California) was recently elected vice-president of The Texas Corporation.

P. C. McConnell, chief petroleum engineer, Bahrein Petroleum Company left California for his return to Bahrein early in October.

A. E. Fox of the drilling department of N.P.P.M. recently arrived in Los Angeles from the East Indies accompanied by his wife. After a very brief visit in California, Mr. and Mrs. Fox departed for New York.

William C. Childers, superintendent of machine shops at San Tome for Mene Grande Oil Company arrived at Los Angeles accompanied by his wife and family at the end of September and have since left for San Francisco whence they expect to sail for New York arriving late in November.

A. Frank Driscoll, drilling superintendent for Iraq Petroleum Company met Mrs. Driscoll in New York during October and left for the West Coast where they expect to spend some time.

Williard B. Goodwin of the construction department of the California Arabian Standard Oil Company sailed from San Francisco for Bahrein Island on October 10.

Dan Sullivan, petroleum engineer formerly with Colombian Petroleum Company (Texas & Socony-Vacuum) at Cucuta, Colombia returned to the west coast on a long leave. He has since been assigned to the New Orleans office of The Texas Company.

T. J. Beals, accountant for Jersey Standard smiling good-bye as he sailed from New York for South America on October 24.

Charles F. Sabourin, general manager, Cia. de Petroleo Lago, with Mrs. Sabourin leaving New York for Caracas where they have been transferred from Aruba. Mr. and Mrs. Sabourin sailed aboard the Santa Paula on October 3.

R. B. Block of the International Petroleum Company with Mrs. Block arrived in New York early in October from Los Angeles. Mr. & Mrs. Block were formerly stationed at Guayaquil, Ecuador and sailed from New York, October 10 for a new post at Negritos, Peru where Mr. Block is connected with the drilling department of International Petroleum. They were accompanied from Los Angeles as far as Barranquilla, Colombia, by Mrs. Gates, wife of John M. Gates, drilling superintendent of the Tropical Oil Company at El Centro, Colombia.

L. A. Riches, an executive of Shell-Mex, with Mrs. Riches sailing from New York on the ss. Brazil bound for Argentina after a four months' vacation.

Philip Nolan, chief geologist of the Mene Grande in Caracas with his wife and daughter just before sailing from New York on October 24.

Photographs on this and the facing page are by Cosmo-Sileo.

Left, W. G. Corwin, vice-president of Colombia Petroleum Company, with Mrs. Corwin on the deck of the ss. Santa Paula as they sailed from New York on October 17 for a six weeks' visit to South America.

Right, Dr. Octavio V. Calcano of the legal department of Standard of Venezuela with his wife and five children as they sailed returning from New York to Venezuela on October 17 after a vacation in the States.

HARRY COLLINS POTTS, vice president, Kerotest Manufacturing Company, died suddenly in Washington, D. C. on September 30. Mr. Potts who was connected with the Kerotest Company for 24 years and active in the American Petroleum Institute, had gone to Washington to witness the launching of the Liberty ships died shortly after being taken suddenly ill in his hotel room. Mr. Potts was born in Columbus, Ohio in 1870; he is survived by a son.

Left, Mr. & Mrs. Raymond H. Ebbets, general superintendent, International Petroleum Company, sailed from New York on October 25 for Talara, Peru where they have been stationed for 24 years. Above, L. A. McVey, sales executive of Socony-Vacuum leaving New York for a short business trip to Venezuela on the 24th of October. Right above, Frank S. Campbell, general superintendent, Lago Oil & Transport of Aruba sailing from New York on October 17.

ENGINEERING executives representing the refining, marketing, and pipeline departments of several major oil companies visited the East Chicago refinery of the Socony-Vacuum Oil Company during October to witness a demonstration of the expansion roof installed by Graver Tank & Manufacturing Company on an 80,000 bbl. gasoline storage tank. The tank was emptied to permit interior inspection and the roof was raised and lowered by compressed air.

Left, L. L. Mariti, Rio de Janeiro manager of Jersey Standard, sailing on the ss. Brazil from New York with his wife on October 25.

Right, Jack W. Green has recently been appointed manager of the Chicago office of Tube-Turns Inc. of Louisville, Ky. Mr. Green will cover a large territory around Chicago.

WORLD OIL PRODUCTION

Figures in U. S. barrels of 42 gal.—Conversion ratios used are weighted averages for individual countries

U. S. BARRELS

	September 1941 Preliminary	September 1940	Jan.-Sept. 1941	Jan.-Sept. 1940
United States	119,871,000	109,337,000	1,028,263,750	1,021,005,000
Soviet Union	16,427,500	21,870,000	187,222,500	183,708,000
Venezuela	18,737,450	14,623,146	158,171,779	144,500,664
Iran	6,424,140	6,700,000	58,459,592	59,191,675
Netherlands India: Sumatra	3,345,060	3,345,000	30,440,060	30,551,986
Borneo	1,117,320	1,070,400	10,167,720	9,776,399
Java	546,360	537,600	4,971,960	4,965,262
Molucca and Other	58,980	60,300	536,780	550,846
Rumania	3,000,000	3,253,201	27,122,120	33,344,317
Mexico	2,730,000	3,400,000	26,248,000	30,002,787
Iraq	800,000	1,500,000	7,500,000	21,225,007
Colombia	2,051,610	2,169,000	17,942,186	19,874,890
Trinidad	1,743,840	1,750,000	15,868,840	14,818,566
Argentina	1,778,100	1,805,564	16,180,592	15,180,229
Peru	1,037,520	1,050,000	9,441,520	9,960,324
Bahrein	528,000	598,924	5,503,800	5,489,141
Burma	645,450	610,114	5,873,490	5,900,559
Canada	810,480	841,752	7,399,330	6,268,565
Brunei	458,430	472,200	4,171,743	4,312,774
Great Germany: Old Reich	366,990	380,000	3,339,612	3,603,959
Ostmark	57,150	59,200	520,109	500,894
Slovakia & Moravia	9,030	9,800	82,130	89,375
Poland	225,000	320,700	2,628,900	2,929,356
Japan	218,100	217,470	1,548,500	1,986,234
British India	186,030	185,400	1,692,916	1,693,627
Ecuador	111,009	208,399	1,114,949	1,854,081
Saudi Arabia	475,740	467,900	4,329,440	3,960,910
Sarawak	107,640	108,700	979,640	992,485
Egypt	629,640	500,600	5,729,640	4,178,367
Italian Empire: Albania	110,000	130,104	1,040,000	1,092,124
Italy	3,810	4,000	34,774	45,350
France	40,000	41,100	356,922	375,498
Hungary	220,000	180,000	1,799,000	1,215,000
Bolivia	10,000	10,600	91,106	84,484
Other Countries	47,670	47,800	433,870	436,597
WORLD TOTAL	184,929,049	177,364,774	1,647,207,270	1,645,660,726

METRIC TONS

	September 1941 Preliminary	Sept. 1940	Jan.-Sept. 1941	Jan.-Sept. 1940
United States	16,218,508	14,793,266	139,131,137	138,142,051
Soviet Union	2,253,429	3,000,000	25,681,961	25,200,000
Venezuela	2,782,100	2,171,217	23,482,958	21,455,184
Iran	838,700	874,787	7,669,319	7,823,972
Netherlands India: Sumatra	428,249	426,270	3,895,187	3,893,309
Borneo	143,044	137,040	1,301,698	1,251,718
Java	69,947	69,210	636,915	629,382
Molucca and Other	7,550	7,710	68,827	70,469
Rumania	406,779	441,112	3,777,575	4,521,264
Mexico	400,881	499,265	3,854,347	4,429,152
Iraq	106,937	200,000	1,002,512	2,837,862
Colombia	286,138	302,510	2,355,032	2,771,946
Trinidad	245,265	246,000	2,231,903	2,083,423
Argentina	253,290	257,202	2,303,505	2,169,546
Peru	136,966	138,613	1,246,303	1,316,856
Bahrein	72,052	81,730	740,556	759,207
Burma	89,150	84,408	810,925	814,671
Canada	103,140	107,120	938,470	797,723
Brunei	60,193	62,970	553,301	575,096
Great Germany: Old Reich	52,479	53,700	472,587	488,510
Ostmark	8,519	9,390	77,544	85,875
Slovakia & Moravia	1,330	1,470	12,151	13,426
Poland	30,327	43,000	354,336	391,984
Japan	31,024	31,000	282,263	283,657
British India	25,694	25,590	233,828	233,780
Ecuador	14,635	27,475	146,989	244,436
Saudi Arabia	64,920	63,400	589,022	536,585
Sarawak	13,539	14,000	124,448	127,735
Egypt	89,922	71,408	818,369	596,735
Italian Empire: Albania	16,486	19,500	155,877	163,500
Italy	473	500	4,325	5,610
France	5,612	5,760	50,061	52,608
Hungary	29,597	24,200	242,038	163,225
Bolivia	1,296	1,394	11,948	10,049
Other Countries	6,800	6,800	61,892	62,379
WORLD TOTAL	25,294,971	24,299,017	225,325,049	225,002,985

Official Crude Oil Production Figures from 1938 to 1940

	Daily Averages Bbl.		Daily Averages Metric Tons		Total Bbl.			Total Metric Tons		
	Jan.-Sept. 1941	Jan.-Sept. 1940	Jan.-Sept. 1941	Jan.-Sept. 1940	1940	1939	1938	1940	1939	1938
United States	3,766,533	3,730,936	509,637	504,168	1,351,849,500	1,264,962,000	1,214,355,000	182,904,869	171,152,192	164,346,325
Soviet Union	685,796	668,029	94,073	91,970	249,318,000	216,727,024	206,192,000	34,200,000	29,530,168	28,859,000
Venezuela	579,383	525,456	86,018	76,303	184,761,241	205,783,650	188,429,050	27,432,998	30,533,706	27,845,286
Iran	214,137	215,242	28,092	28,554	79,151,675	78,151,332	78,320,840	10,443,546	10,367,117	10,358,495
Netherlands India: Sumatra	111,392	111,098	14,268	14,209	40,586,986	41,557,013	34,538,128	5,172,209	5,320,320	4,662,836
Borneo	37,246	35,550	4,768	4,568	12,987,599	13,125,425	12,812,383	1,662,718	1,680,377	1,719,783
Java	18,212	18,053	2,333	2,297	6,514,462	6,568,714	6,955,283	836,982	842,237	933,595
Molucca and Other	1,966	2,003	252	257	731,746	836,144	607,622	93,569	107,047	81,560
Rumania	99,348	121,252	13,837	16,501	42,524,988	46,020,000	48,366,000	5,766,099	6,240,000	6,603,000
Mexico	96,146	109,101	14,118	15,799	40,314,787	39,428,141	38,505,824	5,843,395	5,794,635	5,716,423
Iraq	27,472	77,181	3,672	10,357	24,225,007	30,791,132	32,404,000	3,238,878	4,115,845	4,345,000
Colombia	65,722	72,272	8,626	10,116	25,592,890	23,857,000	21,581,588	3,569,434	3,327,336	3,007,935
Trinidad	58,127	53,885	8,175	7,603	20,218,566	19,270,256	17,736,176	2,842,918	2,710,515	2,472,943
Argentina	59,269	55,200	8,437	7,918	20,616,928	18,738,003	17,076,237	2,936,880	2,657,232	2,432,857
Peru	34,584	36,219	4,565	4,806	12,985,284	13,587,906	15,908,279	1,716,195	1,798,557	2,099,885
Bahrein	20,160	19,960	2,712	2,770	7,095,370	7,588,554	8,297,998	968,502	1,045,391	1,130,734
Burma	21,514	21,456	2,970	2,973	7,730,901	7,872,981	7,499,498	1,067,895	1,087,424	1,039,960
Canada	27,103	22,794	3,437	2,911	8,718,053	7,837,503	6,965,457	1,109,440	997,487	879,921
Brunei	15,281	15,828	2,026	2,099	5,729,374	5,767,227	5,387,214	764,006	768,320	707,123
Great Germany: Old Reich	12,233	13,105	1,749	1,983	4,543,954	4,487,491	3,850,044	653,590	647,337	552,074
Ostmark	1,905	1,821	284	313	718,494	693,247	370,038	114,045	109,904	63,468
Slovakia & Moravia	301	325	44	49	118,775	119,380	132,005	17,836	18,103	19,282
Poland	9,629	10,652	1,297	1,273	3,891,456	3,898,044	3,828,438	520,984	522,874	504,678
Japan	5,672	7,222	1,034	1,035	2,638,644	2,652,930	2,511,184	376,657	379,161	356,328
British India	6,201	6,158	856	853	2,249,835	2,332,467	2,330,269	310,596	322,160	322,125
Ecuador	4,084	6,742	538	892	2,349,015	2,312,118	2,257,278	309,686	306,824	319,877
Saudi Arabia	15,858	14,403	2,157	1,958	5,364,610	3,933,904	495,135	726,785	536,366	66,683
Sarawak	3,588	3,609	456	466	1,317,185	1,329,645	1,624,882	168,475	171,322	200,126
Egypt	20,987	15,194	2,997	2,177	6,053,367	4,603,797	1,561,231	846,514	657,570	223,058
Italian Empire: Albania	3,809	3,971	570	584	1,497,124	1,393,727	437,597	224,199	208,279	65,313
Italy	127	165	16	20	57,350	91,330	106,083	7,110	11,346	13,178
France	1,307	1,365	183	192	496,420	500,815	516,240	69,578	70,478	72,106
Hungary	6,589	4,418	886	596	1,755,000	815,248	330,829	236,025	109,896	42,798
Bolivia	333	292	43	36	110,484	100,885	106,620	14,249	11,998	13,262
Other Countries	1,589	1,593	226	227	579,997	578,036	243,000	82,779	82,300	34,080
WORLD TOTAL	6,033,603	6,002,460	825,352	818,633	2,175,395,067	2,078,313,069	1,982,639,390	297,267,641	284,241,224	279,111,097

Detailed monthly reports were published in February, 1941 issue.

THUNDER in the EARTH . . .

. . . A novel by Edwin Lanham, published by Harcourt, Brace and Company ($2.75: World Petroleum Book Department).

THIS recently published novel, written under a Guggenheim grant by a native of West Texas, deals intimately with the oil industry of the early 1930's. In this case oil does not furnish the background for a novel of human relationships so much as it comprises the motivating force reflected in the behavior of the people exposed to its more violent manifestations. The novel is primarily about oil and its impact on the character of a man and of a Texas town. Mr. Lanham is apparently well acquainted with towns such as Lebanon, the scene of the story, and with the whole Mid-Continent and Texas oil area. Members of the petroleum industry will be interested in the sound manner in which technical questions of geology, drilling practice, crude transportation and marketing are handled. Mr. Lanham is apparently also entirely familiar with oilfield terminology and practice.

The story opens with Cobb Walters completing a dry hole as a roughneck in Oklahoma and leaving for his native Texas in search of a new job. From a promoter who furnishes the job, Walters learns the outline of an important if unsound technique by which he raises himself from itinerant roughneck to wildcat producer, financier and oil company executive in his native town where a successful wildcat discovery changes the character of the entire community and of Walters himself. The closing chapters outlining the final disintegration of his character afford some dramatic scenes and while the book ends without having returned its principal character to a state of equilibrium in which it first picked him up, the general direction in which he is headed is made sufficiently clear in the final sentences.

Mr. Lanham's style is matter-of-fact and with the exception of the two characters in which he is principally interested—Cobb Walters and the town of Lebanon—does not outline the supplementary characters too clearly. He does manage to recreate an authentic atmosphere and to describe without sensationalism an oil boom in a small town in 1930. The action takes place over the span of a single year paralleling the discovery of East Texas, its development to a 300,000 barrel per day field with unrestricted production, martial law, and the beginning of orderly production governed by principles of conservation. Proration plays an important part in the development of the fictitious Lebanon field and Cobb Walters' opposition to it is evidence of the change oil has wrought in his character. The sound and well informed handling of the broad political and economic as well the spiritual and technical factors make this a book of unusual interest and one that oil men will appreciate.

Right, this cable tool rig with wooden derrick in the Kilgore area of East Texas drilling in the early 1930's must have resembled very closely early operations described in Lanham's book: below, martial law in East Texas, a development that had a profound influence on the development of the story in Thunder in the Earth.

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WORLD PETROLEUM ABSTRACTS

Summaries of the Most Important Articles as Published in the Oil Press of the World Dealing with Technical and Economic Aspects of the Petroleum Industry — Edited by Dr. O. W. Willcox.

GEOPHYSICS

Geochemical Well Logging—W. R. Ransome, in GEOPHYSICS, Vol. 6 (1941), No. 3, pp. 287-293.

The principle of geochemical prospecting for oil is now more or less established. As is well known, this method of looking for oil is based on the fact that small traces of hydrocarbons contained in a buried oil-bearing formation may diffuse or migrate upward through the overlying rocks until they reach the surface soil. By analyzing the soil of a district suspected of containing oil formations, those places showing the most evidence of migrating hydrocarbons are considered the best places to put down an exploratory well.

The present paper deals with a further development of this idea. If the hydrocarbons pass upward to reach the top soil, it is logical to expect that some will be contained in the rocks at depths all the way down below the surface. It may also be presumed that the rocks will show larger traces of hydrocarbons, the closer these rocks are to the real oil horizons.

On these presumptions is based a method making a "chemlog" of the cuttings and cores of a wildcat well. Samples of cuttings are taken at intervals and examined for the presence of hydrocarbons and free hydrogen. The author presents a number of "chemlogs" on which suggestive indications may be seen, and which have been more or less confirmed by the drill.

These chemlogs exhibit certain properties which determine their usefulness. First of all it is clear that recognizably high hydrocarbon values occur at the productive horizons in a well. As the chemlog is made while drilling is carried on it may indicate:

1. When and where to core, thus saving unnecessary coring.
2. Whether electrical, side wall core, drill-stem or other testing is needed.

This detection or location of producing horizons means that unsuspected pay zones will not be passed through. It also suggests that gas may be distinguished from oil production.

Another characteristic of the displayed chemlogs is the shape of the depth concentration pattern. This property may be used for prediction which gives rise to another set of applications:

1. When to drill ahead on a well that might otherwise be abandoned before it reaches production.
2. When to abandon a well that might be uselessly deepened.
3. When a dry hole or edge well may be close to pay laterally.

These advantages suggest that the geochemical well log will be used as a guide in drilling operations on wildcat wells; and that it will also be used in conjunction with other methods after the well has reached its final stages, and a decision is being made whether to abandon or set casing and test. The method is still subject to development and other practical applications should be discovered as more experience is gained.

Well Logging by Radioactivity—William L. Russell, in BULLETIN AMERICAN ASSOCIATION PETROLEUM GEOLOGISTS, Vol. 25 (1941), No. 9, pp. 1766-1788.

Radioactivity logging is the only known method of making accurate lithologic records through the casing and cement. The radioactivity of the strata is determined by measuring the variations in conductivity produced by gamma rays in the gas in an ionization chamber contained in the subsurface instrument. It has been found that each formation tends to produce a curve of characteristic shape on the radioactivity logs, and that some of these characteristic curves are highly persistent laterally.

At present, the radioactivity logs are used chiefly to determine the position of the producing sands behind the casing, in order that the pipe may be perforated to drain them most effectively, and the process has been highly successful in this use. Other applications consist in determining the amount of sample lag, making correlations and cross sections, mapping subsurface structure for deeper drilling, and surveying potash deposits. A similar process may be used in making radioactivity surveys at the surface and in mines.

SPECIAL RESEARCH PROBLEMS REQUIRE SPECIAL EQUIPMENT

Complex drilling problems incidental to modern deep drilling are studied by Baroid engineers with the aid of equipment especially designed to analyze or reproduce conditions encountered or anticipated in the field.

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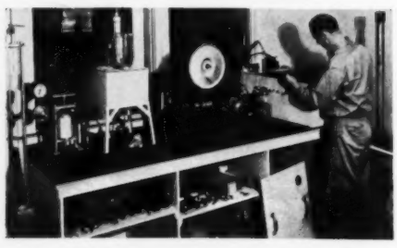
ONE OF MANY STEPS IN CLAY RESEARCH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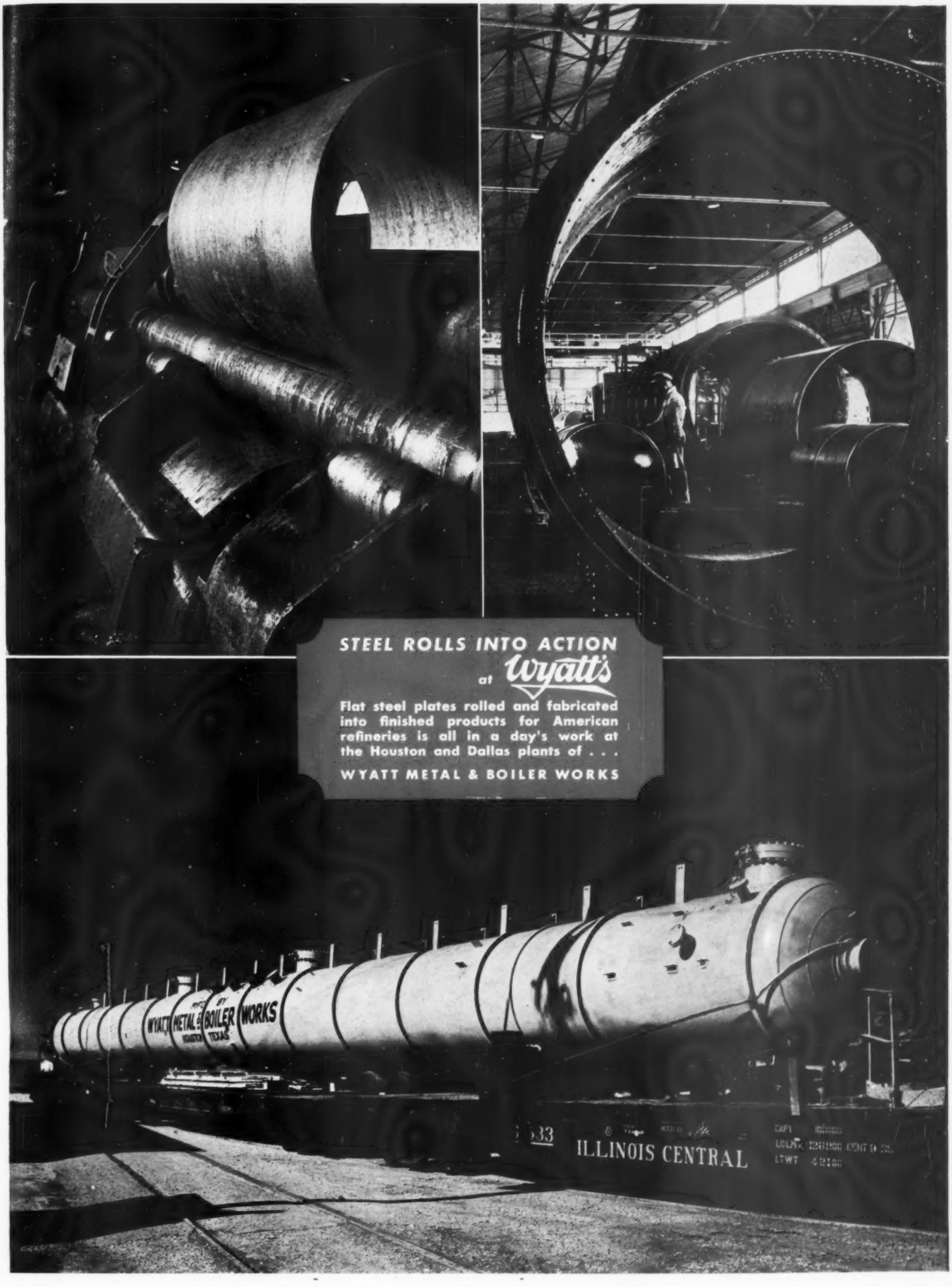
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The most obvious use of gamma-ray logs is to determine where to gun-perforate the casing, and most of the surveys have been made for this purpose. In cases where there are no reliable logs of the well surveyed, it is necessary to correlate the gamma-ray log with the sample log of some well in the vicinity, in order to identify the formations and to differentiate between the sandstones and limestones. Generally, the geologic units stand out so clearly on the radioactivity logs that a geologist thoroughly familiar with the stratigraphy of the area can identify the formations immediately.

DRILLING

Control of Filtration Characteristics of Salt-Water Muds—G. R. Gray, J. L. Foster and I. S. Chapman, in PETROLEUM TECHNOLOGY, September, 1941. Technical Publication No. 1351; 9 pages.

This paper opens with the statement that the wall-building properties of fresh-water muds are commonly regulated by the addition of bentonitic clays, or of agents to promote the dispersion of the natural mud solids. When strata bearing soluble salts are encountered in the course of drilling, the salts are incorporated in the mud; the clay solids are flocculated and water loss is increased tremendously. Methods generally used in controlling filtration of fresh-water muds are no longer applicable.

The problem of reducing water loss from salt-water muds is not confined to any particular area, but is acute in parts of West Texas. Salt beds several hundred feet thick must be penetrated before the oil-bearing formation is reached. Since the formation drilled does not provide mud-making material, it is necessary to use large quantities of commercial clays, and even the best commercial clay does not afford relief from the problem of high filtration.

Laboratory tests indicate, and field use demonstrated conclusively, that filtration characteristics of salt-water muds can be improved markedly by the addition of natural gums or gelatinized starch. Additional evidence of improvement in wall-building properties was afforded by freedom from stuck drill pipe and ease of running casing to bottom in holes drilled with treated muds.

The extensive use of gums has not been undertaken because both supply and cost have been uncertain since the beginning of war abroad. Starch, on the other hand, is readily available from a number of domestic sources. Pasted starch has been added to the mud used in drilling the productive section in about 80 wells in West Texas.

Although this study was directed particularly toward a solution of drilling-mud problems in West Texas fields, the results are applicable to other areas in which the mud becomes contaminated with salt. In the Gulf Coast, for example, overhanging, mushroom-type salt domes occur occasionally, and in marine operations it is frequently necessary to use sea water in making mud. In such conditions, wall-building properties of the drilling mud can be improved by the addition of gums or gelatinized starch.

In preparing the pasted starch for field us, a box fitted with perforated steam coils was employed. Starch was intimately mixed with water by adding the starch through a mud-mixing hopper. Caustic soda was added, and the white, pasty mass was agitated with steam until a viscous, straw-colored suspension resulted. The final composition of the mixture was approximately 89 percent water, 10 percent cornstarch and one percent caustic soda. The mud in the pit was stirred vigorously with the gums while the starch suspension was added.

A Comparison of Marsh-funnel and Stormer Viscosities of Drilling Muds—J. E. Owen, in PETROLEUM TECHNOLOGY. September, 1941, Technical Publication No. 1373; 9 pages.

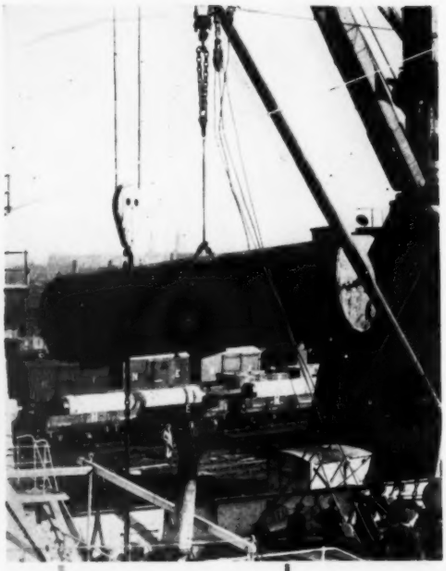
Experiments on twenty-six drilling muds were carried out in an effort to establish a correlation between the apparent viscosity values for these muds as obtained with the Marsh funnel and the Stormer viscometer. This required a calibration of both instruments in which the density of the calibrating liquids was taken into account. Corresponding to the Marsh-funnel viscosity values that were obtained at 1500 c.c. in, 1 qt. out, equivalent Stormer viscosity values were obtained at a Stormer cylinder test speed of approximately 1100 r.p.m. Further, a linear relation between the logarithms of the Stormer cylinder test speed and the resulting apparent viscosity was found to exist for the muds tested for 200 to 1000 r.p.m. The significance of the slope of this linear relationship is discussed as it applies to the field use of drilling muds. It was concluded that Marsh-funnel viscosity measurements are expressible in absolute units that may be correlated with Stormer viscosity measurements, provided these are made in the manner described in the paper.

OPERATION

Solubility of Paraffin Waxes Deposited in Oil Wells—T. Y. Ju and Others, in OIL & GAS JOURNAL, Vol. 103 (1941), No. 2, pp. 34, 38, 40, 42.

Attempts to use solvents for removal of paraffin from oil wells have been made for a long time, but this has not yet become technically practicable, which in part may be ascribed to lack of fundamental solubility data. The principal result obtained in this research is the finding that carbon tetrachloride, on account of its better penetration and non-inflammability, is at least the most promising solvent for removing waxes from tubing, and as such is worthy of close attention.

MODERN INDUSTRIAL PLANT



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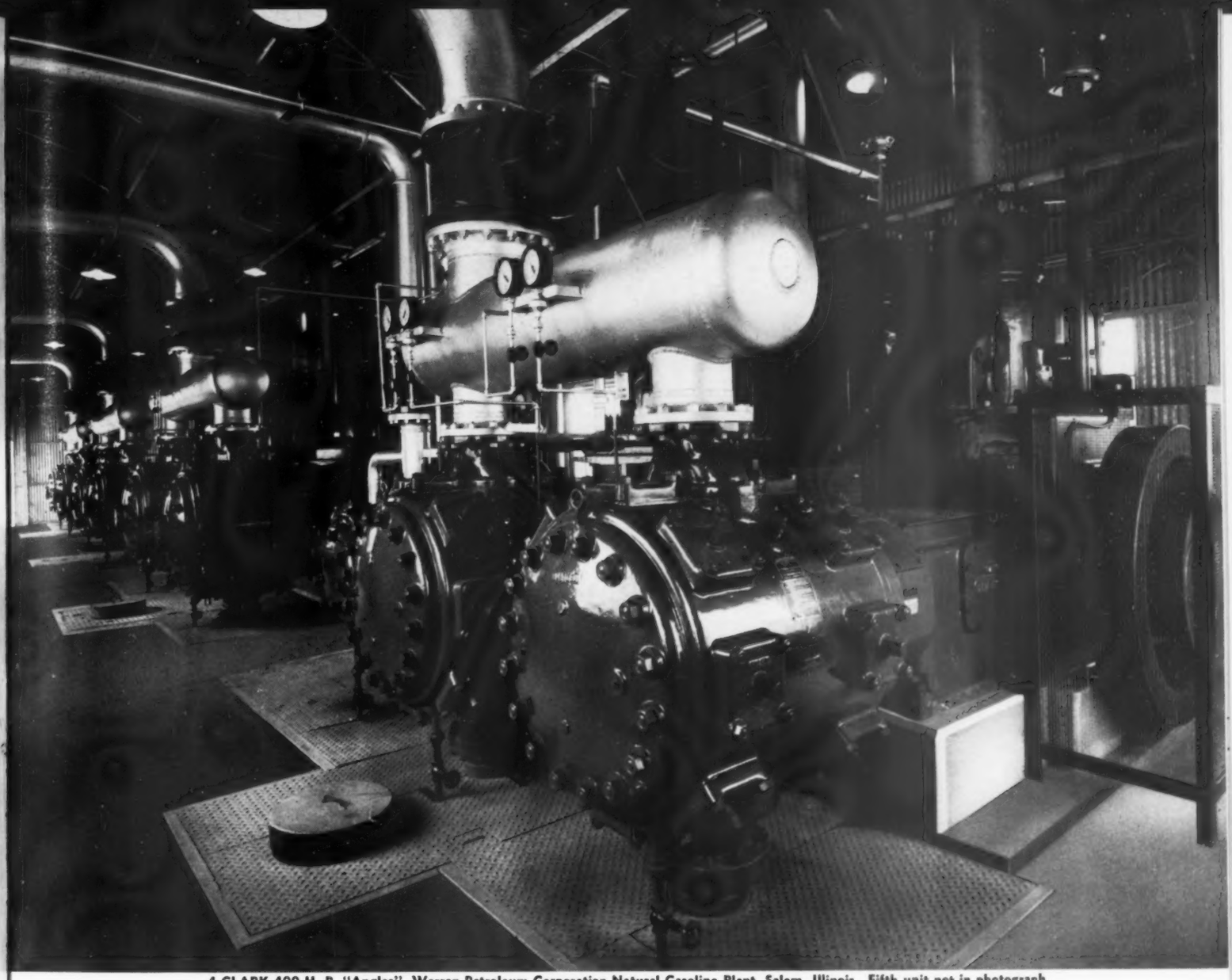

4 CLARK 400 H. P. "Angles", Warren Petroleum Corporation Natural Gasoline Plant, Salem, Illinois. Fifth unit not in photograph.

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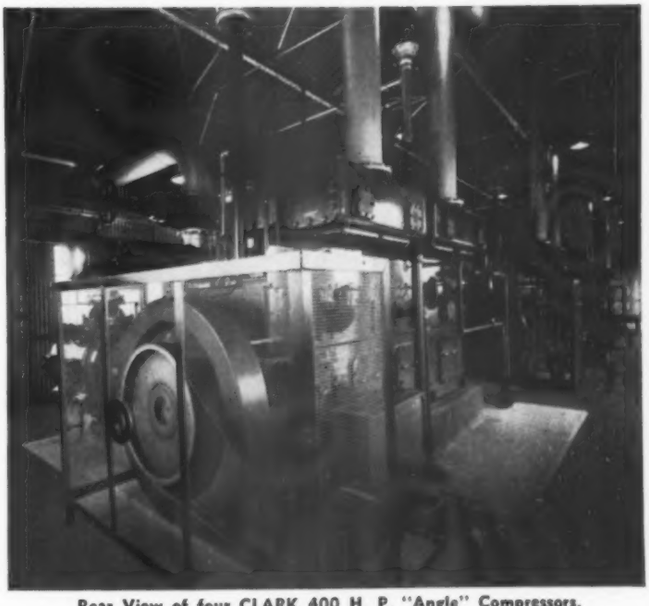


Rear View of four CLARK 400 H. P. "Angle" Compressors. Fifth unit not in photograph.

NATURAL GAS

Natural Gas Hydrates—Don B. Carson and Donald L. Katz, in PETROLEUM TECHNOLOGY, September, 1941. Technical Publication No. 1371; 8 pages.

Natural gases under pressure form crystalline hydrates with water. Experimental data are reported on four-phase equilibrium for the methane-propane-water, methane-pentane-water, and methane-hexane-water systems. Temperatures and pressures for equilibrium between gas, water-rich liquid, hydrocarbon-rich liquid, and hydrate were measured, as well as the percentages of methane and propane in the hydrate. The data indicate that natural gas hydrate behaves as a solid solution and that pentanes and heavier hydrocarbons do not enter into the solid phase. Vapor-solid equilibrium constants are presented that permit the approximation of the conditions for hydrate formation, from the composition of a gas.

Recovering Isomers From Natural Gas—H. W. Warts, before NATURAL GASOLINE ASSOCIATION AMERICA, Dallas meeting, April, 1941.

Under the pressure of low prices and shrinking income, various natural gasoline manufacturers have tried to make more business from secondary products obtained by close fractionation. The first point of attack was propane-butane, which went mostly into liquid gas. Next the expanding demand on the refineries for higher-octane motor fuels created a demand for the isomers, which occur in small quantities in practically all natural gas. Iso-butane, in particular has obtained considerable value and a ready market for use in alkylation and other new refinery processes. The problem then became mainly one of close fractionation to separate the iso- and normal pentanes, and iso- and normal butanes, the one from the other. This separation has presented the natural gasoline manufacturer with a difficult problem of fractionation, and the author goes into considerable detail to show how difficult it is. Extremely expensive equipment and very accurate control are necessary; the specifications as to purity are exacting, and necessitate low temperature fractionating; the slightest deviation in tower control may throw all products in storage off specifications.

In the new plant of the Warren Petroleum Corp. at Salem, Ill., which manufactures commercially pure propane, isobutane and normal butane, in the case of isobutane the cost of making the isobutane cut is given thus:

Initial cost of column and accessories	$35,000.00
50,000 gal. storage of 114 lb. V.P.	10,000.00
Total	$45,000.00
Cost per gallon	11.25
Operating and maintenance cost per month	1,000.00
Cost per gallon	.0082

These figures do not take into consideration loading losses, tank-car rentals or payment for gas, but represent only the manufacturing expense.

The paper ends with the advice that before any expenditures are incurred relative to the extraction of isobutane at a natural-gasoline plant, a great deal of thought should be given, not only to the possible income derived, but also to the engineering and data in connection with the actual construction and operation of the unit. One should realize that any isobutane available is in the raw make and not in the fractional analysis of the gas, that at least 20 per cent of the available product will be lost in the various fractionators, and that even with the best operation, considerable difficulty is continually experienced in keeping the columns working in unison in order to recover a product meeting the expected specifications.

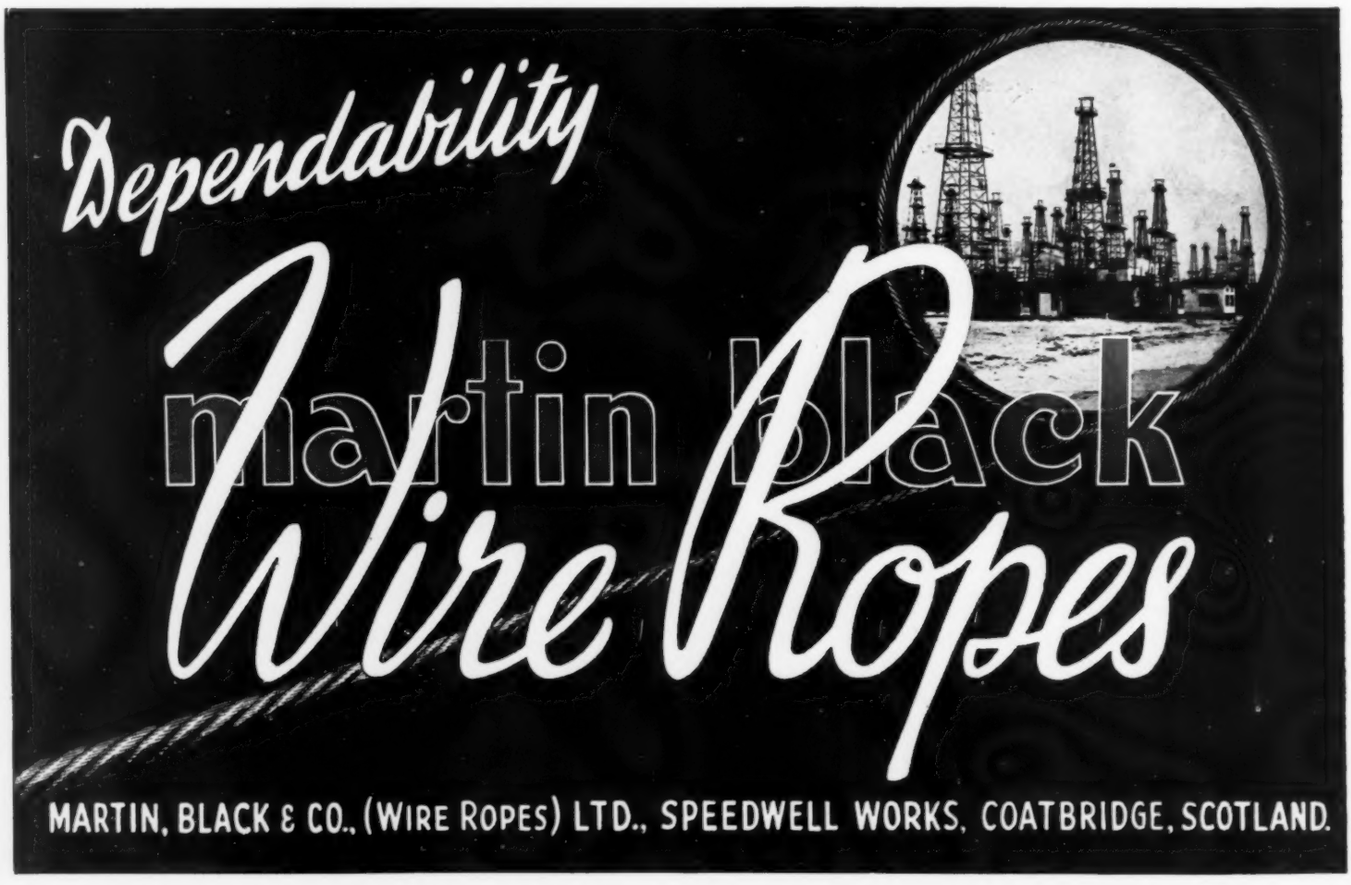
REFINING

Connection Between Oil Absorption and Bleaching Action of Clays—Eduard Erdheim in MINERALOEL, Vol. 14 (1941), No. 3, pp. 99-107.

Samples of decolorizing clays were separated into fractions by sieving; each fraction was tested for its oil-holding and its decolorizing ability. It turned out that the coarser fractions held more oil than the finer fractions, and that the greater the ability of the particles to retain oil the weaker was the decolorizing effect. From these results it is concluded that the manufacturers of bleaching clays should endeavor to granulate their goods so as to combine the least absorption of oil with the greatest decolorizing action. Correspondingly the users of these clays should scrutinize these two points in making their purchases.

Dehydration and Desalting of Colombia Crude—Ben T. Zwick in OIL WEEKLY, Vol. 107 (1941), No. 10, pp. 107-108; 110-112; 114.

This article describes experiences which show the necessity of changing operating methods to meet changing conditions in the field. As the field becomes larger by the drilling of new wells and as more wells make salt water, the installed equipment becomes a bottleneck and a way must be thought up to speed



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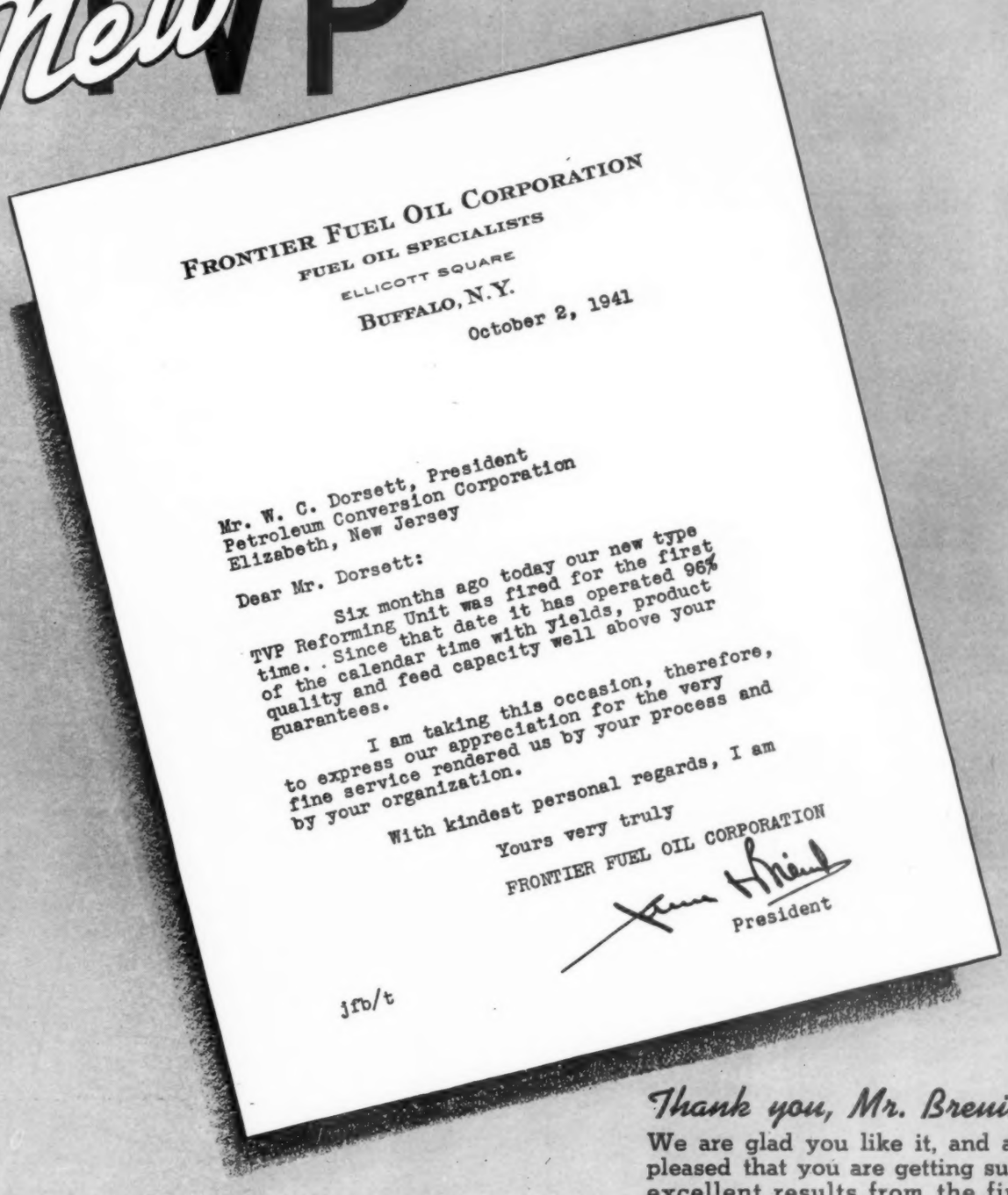

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the throughput. Faster settling of the water from the chemically treated emulsion is imperative.

In this connection the author contributes a description of specially designed excelsior tanks. The tanks are of 2000 barrel capacity, 21 feet 6½ inches I.D. by 32 feet 6½ inches high, divided into 8 sections from the bottom up, 3 feet ¾ inch to each section, with an 8 foot 5⅛ inch surge chamber at the top. All sections, except the bottom 3-foot section and the surge chamber, are packed with excelsior. The emulsion enters the bottom section, passing through the excelsior of each succeeding section, alternating from the shell of the tank to the center. About 85 percent of the water in the emulsion is drawn off at the different levels and the oil leaving the surge chamber usually has 2 percent or less B. S. & W.

Not every kind of excelsior gives good service. The best was made from a local hardwood of about the hardness of oak; soft white poplar tends to pack.

A coarse cut excelsior works much better than a fine cut. About 10,000 lbs. of the coarse hardwood excelsior is required to fill a tank as compared with 13,000 lbs. of white poplar fine cut. One filling is good for six months operation. The most favorable throughput was found to be not over 6000 bbl./day.

PHYSICS

Viscosity Measurement—M. R. Cannon and M. R. Fenske, before DIVISION OF PETROLEUM CHEMISTRY, AMERICAN CHEMICAL SOCIETY, St. Louis meeting, April, 1941.

This paper describes a modification of the Ostwald viscometer which is particularly suitable for measuring the viscosity of opaque liquids. It is also designed for the purpose of obtaining data on shearing rate as a function of shearing stress. Such data are of fundamental importance in investigations of plastic fluids and lubricating oils at low temperatures. A lube oil with a pour point of 0°F. may be either a plastic fluid or a true Newtonian liquid in the neighborhood of 0°F. This instrument can be used to determine the type of fluid and is of value in the study of effect of pour point depressors, dewaxing, etc., on the shearing rate-shearing stress relationship.

This index turns out to be the iodine number multiplied by the boiling index (Kennziffer) divided by 100. One more reference point is needed; the volatility ("Vergasbarkeit," *Vg.*) which is the average proportion by volume that distills between 60° and 100°C., including distillation loss.

With this data in hand the octane number may be found with a graph. Applying this method to the products of practically all the synthetic gasoline plants in Germany between August, 1939, and May, 1940, it is found that 60 per cent of all analytical values agree with the CFR method, 20 per cent agree within 1.5 unit, and the rest within 3.5 and 5 units. Out of 100 unmixed samples, most were between 50 and 60 octane number.

The Permeability of Porous Media to Liquids and Gases—L. J. Klinkenberg, before AMERICAN PETROLEUM INSTITUTE, 11th Mid-Year Meeting, Tulsa, May 1941.

The standard procedure for determining the permeability of porous media according to *API Code No. 27* (first edition, October, 1935) is based on the fundamental assumption that, as long as the rate of flow is proportional to the pressure gradient, the permeability constant of a porous medium is a property of the medium, and is independent of the fluid used in its determination.

Although this is true for most liquids, the investigation has shown that the permeability to a gas is a function of the mean free path of the gas molecules, and thus depends on factors which influence the mean free path such as the pressure, temperature, and the nature of the gas. Therefore, when the mean free paths are small, e.g., at high pressures, the permeability to gas should be expected to approach that for liquids. The experimental data which support these conclusions are discussed.

CHEMISTRY

Investigation of High-Boiling Petroleum Oils by Absorption Analysis—B. C. Allibone in JOURNAL INSTITUTE PETROLEUM, vol. 27 (1941), No. 209, pp. 94-108.

This paper describes the application of "chromatographic adsorption" to the analytical separation of the high-boiling compontnts of petroleum. A distillation cut of restricted boiling range is dissolved in aromatic free petroleum ether, b. pt. 60-80° C., and the solution filtered through a column of adsorbent. The adsorbent may advantageously be silica gel. After the addition and exhaustion of the primary solution, fresh petroleum ether is added to the top of the column and the filtration continued until the high-boiling material recovered from a unit of filtrate approaches a specific

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gravity of unity. The adsorbent is then drained by suction, removed from the column, and allowed to dry. The dried adsorbent is divided into suitable portions as its variation in color or other consideration may dictate, and extracted with a solvent or a succession of solvents. By these means, with variations to suit individual stocks, high-boiling cuts, whether distillates or residues, may be separated into a succession of components of widely varying physical characteristics.

The procedure is to dissolve 50 grams of the oil in 500 ml. of the petroleum ether; the percolated liquid is collected in fractions of 50 ml.; each fraction is evaporated and the residue examined. The drained silica gel is then extracted with methyl ketone.

The method is widely applicable to the study of heavy oils by the separation of components of widely different properties, with special reference to lubricating or wax-bearing stocks. Bauxite appears to separate high-molecular-weight residual stocks almost as well as does silica gel, but is not so efficient in the resolution of distillate stocks.

ASHPHALT & TAR

Determination of Wax in Asphaltic Products. A Propane-Hexone Method—E. C. Knowles and Harry Levin before DIVISION OF PETROLEUM CHEMISTRY, AMERICAN CHEMICAL SOCIETY, St. Louis meeting, April, 1941.

A new method is described for determining wax in asphalt. It comprises separating the asphaltene-resin fraction from the oil-wax fraction by hot liquid propane under pressure and determining the wax in the oil-wax fraction by crystallization at low temperatures from solution in methyl isobutyl ketone (hexone). The mild condition of the propane treatment effects a clean removal of the asphaltene-resin fraction, which interferes generally with crystallization methods for wax. Thus, it avoids the detrimental effects of more drastic pretreatments, such as digestion with strong sulfuric acid or destructive distillation, which may destroy some of the wax.

Hexone possesses the necessary properties of an outstanding reagent for wax determinations — namely, high oil solvent power, low wax solvent power, and good filtration rates.

Data are given on asphaltic samples containing known additions of wax. The new method shows the wax content of many asphalts to be higher than has long been assumed on the basis of the less accurate, though extensively used, Holde method.

BOOKS

Petroleum Development and Technology, 1941—Papers and discussions presented before meetings of the PETROLEUM DIVISION, AMERICAN INSTITUTE OF MINING AND METALLURGICAL ENGINEERS, also PETROLEUM STATISTICS. Published by the Institute. Philadelphia. 587 pages; $5.00.

This volume is the 16th of the Petroleum Development and Technology series of the Petroleum Division, A.I.M.E., and contains papers read before the Institute at its various meetings during the year. There are six chapters and a total of 23 papers (most of which have been published elsewhere) on production engineering, which include engineering research, petroleum economics, production (domestic and foreign), education and refining. As usual, the Statistical and Development section occupies about half the book, and surveys oil field activities in many districts and regions.

GENERAL

Survey of Winter Gasolines 1940-41—E. C. Lane, in BUREAU OF MINES REPORT OF INVESTIGATIONS, No. 3576 (June, 1941).

This is the sixth annual Cooperative Fuel Research survey of gasolines found on the markets of the United States during the Winter of 1940-41.

The conclusions of the present report are based on examination of a total of 2020 samples of regular, premium and third grades sold under 227 brands; in general the quality of automotive fuel supplied to the American public has continued to become better.

Specifically, a comparison of data for the winters of 1940-41 and 1939-40, respectively, for the three grades of gasoline, shows that the average octane number for both the regular- and premium-price grades is 1.7 units higher, and for the third-grade is 1.4 units higher for the winter of 1940-1941 than for the previous winter.

The average vapor pressure for the regular- and premium-price gasolines is 0.4 pound higher and for the third-grade gasolines is 0.2 pound higher than for the winter of 1939-40.

The average temperatures in the distillations for the regular, premium-price, and third-grade gasolines are slightly lower than corresponding values in the previous winter survey in all instances except the initial boiling point.

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State of New York } ss.
County of New York }

Before me, a notary public in and for the State and county aforesaid personally appeared Rex W. Wadman, who, having been duly sworn acccording to law, deposes and says that he is the general manager of the WORLD PETROLEUM and that the following is, to the best of his knowledge and belief, a true statement of the ownership, management (and if a daily paper, the circulation) etc., of the aforesaid publication for the date shown in the above caption, required by the Act of August 24, 1912, as amended by the Act of March 3, 1933, embodied in section 537, Postal Laws and Regulations, printed on the reverse of this form, to wit:

1. That the names and addresses of the publisher, editor, managing editor, and business manager are: Publisher, Estate of Russell Palmer, 2 West 45th St., New York, N. Y. Editor, E. W. Mayo, 2 West 45th St., New York, N. Y. Managing Editor, E. W. Mayo, Jr., 2 West 45th St., New York, N. Y. Business Manager, Sam J. Gallay, 2 West 45th Street, New York, N. Y.

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R. W. WADMAN
(Signature of General Manager)

Sworn to and subscribed before me this 17th day of September 1941.

[SEAL] ELIZABETH M. DONLON
(My commission expires March 30, 1942)